ERDA/JPL 954376-77/3
DISTRIBUTION CATEGORY UC-63

LASER-ZONE GROWTH IN A RIBBON-TO-RIBBON (RTR) PROCESS SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT

Motorola Report No. 2256/6

Technical Quarterly Report No. 5

June 1977

JPL CONTRACT NO. 954376

BY

R.W. Gurtler, A. Baghdadi, J. Wise, R.J. Ellis

PREPARED BY

MOTOROLA INC. SEMICONDUCTOR GROUP
5005 East McDowell Road
Phoenix, Arizona 85008

"This work was performed for the Jet Propulsion Laboratory, California Institute of Technology, under NASA Contract NAS7-100 for the U.S. Energy Research and Development Administration, Division of Solar Energy."

"The JPL Low-Cost Silicon Solar Array Project is funded by ERDA and forms part of the ERDA Photovoltaic Conversion Program to initiate a major effort toward the development of low-cost solar arrays."

(NASA-CR-153908) LASER-ZONE GROWTH IN A RIBBON-TO-RIBBON (RTR) PROCESS SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Quarterly (Motorola,

N77-27504

HC A05/MF A01

Unclas

G3/44 39181

ERDA/JPL 954376-77/3
DISTRIBUTION CATEGORY UC -63

LASER-ZONE GROWTH IN A RIBBON-TO-RIBBON (RTR) PROCESS SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT

Motorola Report No. 2256/6

Technical Quarterly Report No. 5

June 1977

JPL CONTRACT NO. 954376

BY

R.W. Gurtler, A. Baghdadi, J. Wise, R.J. Ellis

PREPARED BY

MOTOROLA INC. SEMICONDUCTOR GROUP
5005 East McDowell Road
Phoenix, Arizona 85008

"This work was performed for the Jet Propulsion Laboratory, California Institute of Technology, under NASA Contract NAS7-100 for the U.S. Energy Research and Development Administration, Division of Solar Energy."

"The JPL Low-Cost Silicon Solar Array Project is funded by ERDA and forms part of the ERDA Photovoltaic Conversion Program to initiate a major effort toward the development of low-cost solar arrays."

TABLE OF CONTENTS

SECTION		PAGE
1.0	RTR Growth Apparatus	1
1.1	Contract Goal Implication	1
1.2	New RTR Facility	2
1.3	New Experimental Table	4
1.4	Operation of New Facility	8
2.0	Crystal Growth and Crystallographic Characterization	8
2.1	Routine Growth Runs	8
2.2	Curved Melt Growth	11
2.2.1	Growth Experiments	11
2.2.2	Results	15
3.0	Material/Device Characterization	17
3.1	Solar Cells	17
3.2	SPV Studies	23
3.3	SPV Material Studies	25
3.3.1	Experiment Description	25
3.3.2	Results	27
4.0	Problems	33
5.0	Plans	33
6.0	New Technology	33
7.0	Program Expenditures	33
8.0	Milestones	34
9.0	Engineering Drawings	34

LIST OF FIGURES

FIGURE	TITLE	PAGE
1	Drawing of Laser Lab	3
2	Beam Table Operation	5
3	Tables With Cover, Moveable Plates Simplified	6
4	Views Showing Drive Motors, Furnace etc.	7
5	Edges View	9
6	Structure	10
7	Curved Melt Drawing	12
8	Curved Melt Sample	13
9	Curved Melt Sample	14
10	Flat Melt Sample	16
11	Photo of Solar Cell (Ribbon)	18
12	"Load" Curve of Solar Cell (Ribbon)	19
13	"Load" Curve of Solar Cell (Control)	20
14	Spectral Response (Ribbon)	21
15	Spectral Response (Control)	22
16	SPV on Ribbon Cell	24
17	Flow Chart for CZ, FZ, Gettering Experiment	26
18	Thermal Experiment Profiles	28
19	Sample 8, Laser Only, Dislocations & SPV	29
20	Sample 4, Laser + Furnace Dislocation & SPV	31
21	Stress Dislocation Correlation	32
22	Total Hours of the Program (1000)	35
23	Total Cost (Including Fee)	36
24	Milestone Chart	37

1.0 RTR Growth Apparatus

1.1 Contract Goal Implications

The primary crystal growth goals for the ERDA JPL contract extension are as follows:

Width	7.5cm
Growth Rate	18 cm/min
Thickness	.01-.025 cm
Efficiency	>12%
Dislocation Density	$<10^4$ cm^{-2}
Length	>10m

The primary requirements which most affect the RTR apparatus are the width velocity and the changeover from a finite stroke machine to a continuous growth capability. The increased width and velocity require an improved scanner and higher laser power as has been reported previously. Briefly, the highly focussed laser beam must approximate a line source of energy and if the scan frequency is not high enough, vaporization and roughening of the surface will result. In addition, the reflectivity of the liquid silicon has been shown to be much higher than expected and at present, our growth velocities are limited to about 7.5cm/min for 1.25cm wide and .1mm thick ribbons. This was accomplished with a laser power of 350 watts (10.6μm). Scaling these numbers to 7.5cm wide, 7.5 cm/min would indicate 2KW would be required from the laser. However, as reported in the March 1977 Quarterly Report, utilization of hemispherical reflectors can improve the energy coupling by at least a factor of two, and use of Nd:YAG lasers at a wavelength of 1.06μm also indicates a substantial coupling improvement.

To achieve the width and velocity goals, and to evaluate the performance of Nd:YAG vs. CO_2 lasers, a trial lease of both lasers was decided upon. After about three months of evaluation of both lasers under similar operation, a decision to purchase one of the lasers will be made. For these evaluations, two Quantronix Nd:YAG lasers, each rated at 375W for a total of 750W, and a Sylvania CO_2 laser rated at 1.5KW were contracted. These two laser systems and the existing 375W Photon Sources CO_2 laser will comprise the system of laser sources for the evaluation period.

1.2 New RTR Facility

Coinciding with the construction of the new equipment is a departmental move from one plant to another. Consequently, a totally new crystal growth laboratory has been designed. Two distinct experimental growth stations will be provided as indicated in Figure 1. Two independent growth stations are provided which can allow growth experiments to be run at one station while experimental modifications are being made at the other. The laser beams are brought to either station by means of a beam table: the beam table is totally enclosed from the point of exit from the laser, to the entrance of each station. Mirrors and lenses within the enclosed beam table are in an inert, filtered atmosphere which will ensure long life for the high power mirrors and lenses. Plumbing and electrical wiring to each station are confined beneath a false floor so as to minimize obstacles around the stations. Each station is equipped with a cover which serves as a personnel protection cover, allowing observation of the experiment through laser-opaque windows.

The tables themselves utilize optical table concepts with provision for magnetic base mounting or hard mounting to an array of 1/4-20 tapped holes in the plate. This will allow a great versatility in design changes or optical layout modifications.

One station will utilize the existing, finite stroke RTR apparatus for experimentation which does not require the special scanning and feed requirements of the new apparatus.

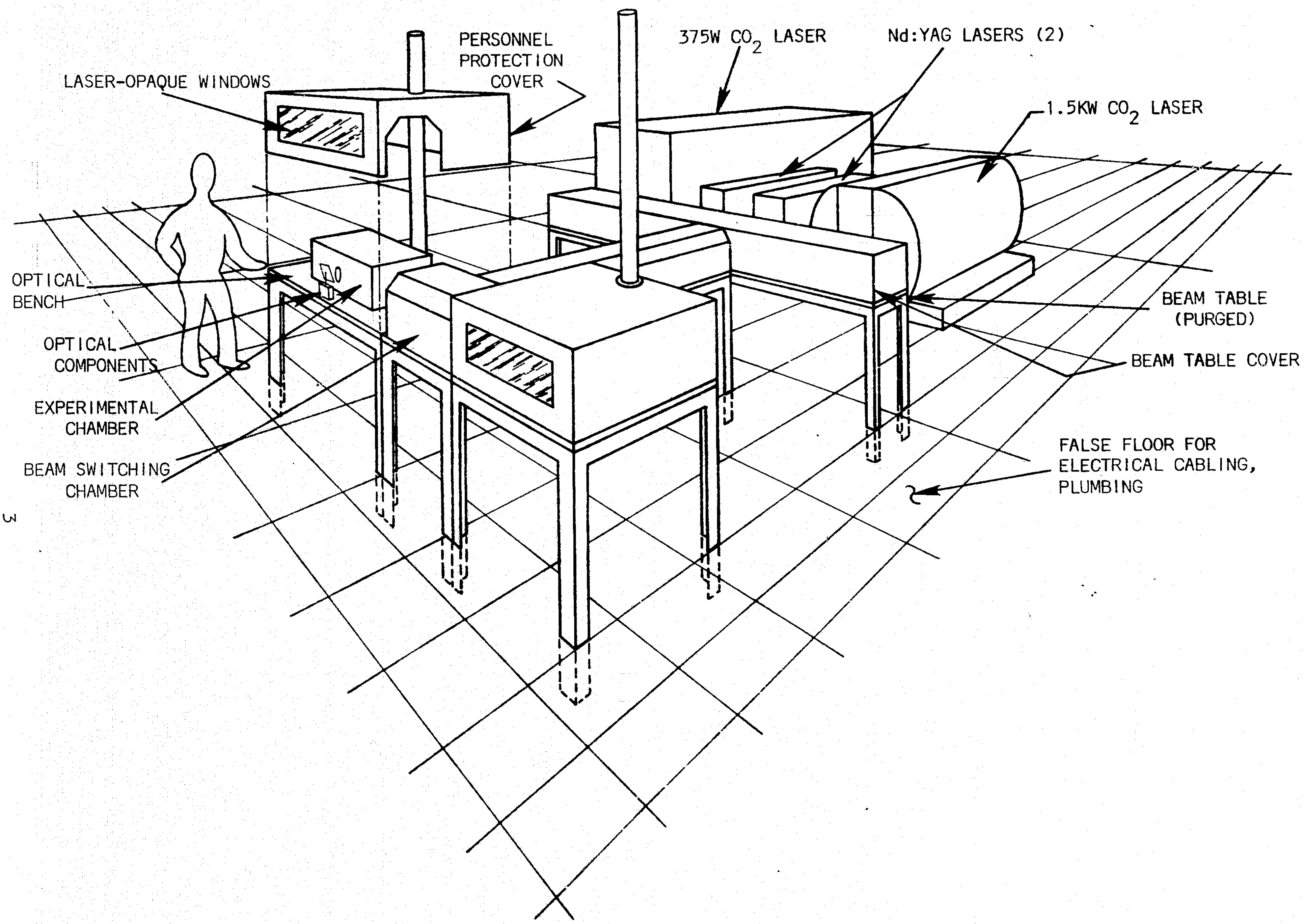


FIGURE 1: LASER LAB

Figure 2 illustrates in more detail how the beam table and experimental tables are configured to allow versatile experimental conditions. Each laser beam can be directed to either table.

At the entrance to each table is an interlocked system of shutters which will not allow the high power laser beams access to the tables unless the cover is in place; low power HeNe alignment laser beams can be allowed to the table for set-up however. Each beam passes through a window at the end of each arm of the beam table; this allows the atmosphere in the beam table to be undisturbed during work on one of the tables.

As indicated in Figure 3, the two Nd:YAG lasers are being used for one experiment on Table I while the high power CO_2 laser is being used on Table 2. Note, that different lenses and mirrors are often required for the two distinct wavelengths and this requires that all mounts be capable of quick changeover.

1.3 New Experimental Table

Figure 2 indicates the general layout of optical components for the new RTR apparatus. Beam directing mirrors and (in the case of the CO_2 laser beams) beam splitters are used to bring two nominally equal beams to the polygon scanners. The scanner assemblies then allow remote adjustment of focus, scan width, and scan position on the sample in the experimental region. Figures 3 and 4 indicate the concept for the table, component mounting and table cover. Basically, to allow for experimental variation, all components related to the upper portion of the uptake transport, transport drive etc. are mounted to a common plate which may be raised or lowered en masse by means of a single column and a couple of adjustable, relocatable support columns around the periphery. All components related to the lower transport, transport drive and ribbon orientation are mounted on the base plate.

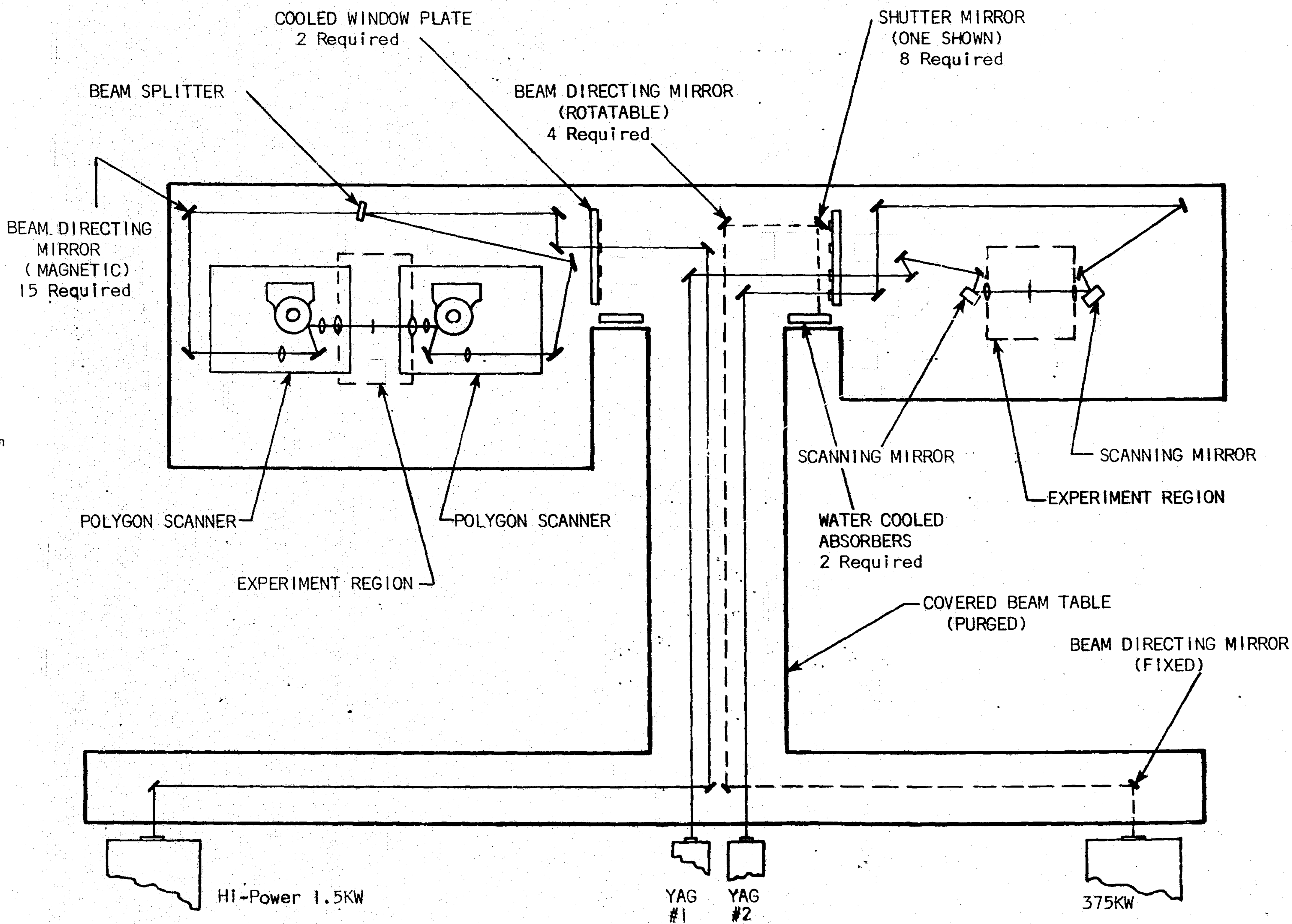


FIGURE 2: BEAM TABLE

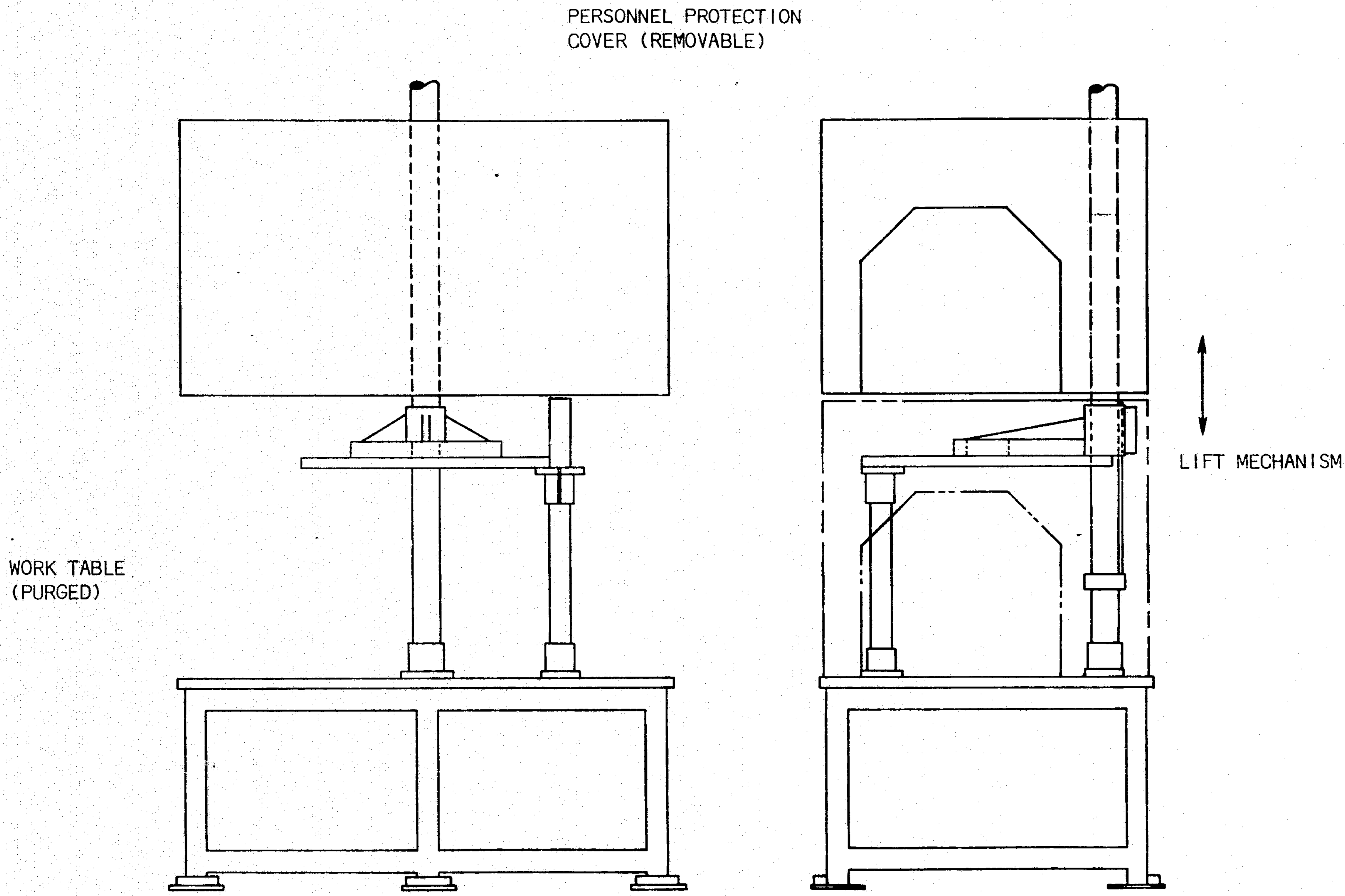


FIGURE 3: CRYSTAL GROWTH TABLE AND COVER

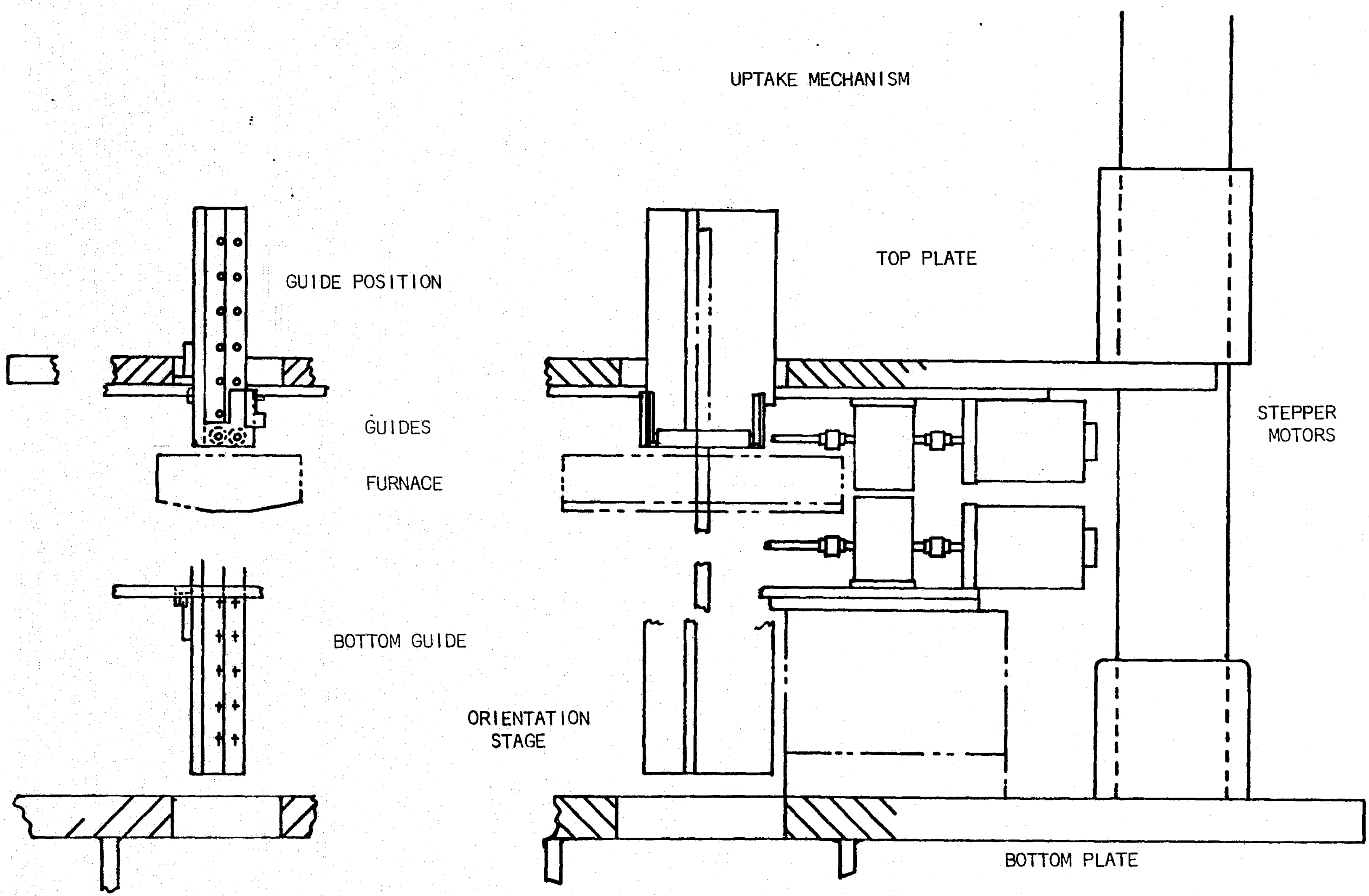


FIGURE 4: DEPLOYMENT OF VARIOUS RTR COMPONENTS

The cover also mounts on the single massive column and may be lowered over the entire apparatus and locked to the base plate, thus making a seal with the table periphery.

Ribbon transport is accomplished by a roller mechanism and will initially be mechanically guided along the edges.

Guiding of the ribbon in the thickness direction will also be accomplished mechanically initially but gas dynamic bearings will be tested and developed. Ribbon transport velocities will be stepper motor controlled and are designed to have a maximum velocity of 25cm/min.

1.4 Operation of New Facility

The move to the new facility is now scheduled in late July and operation is hoped for in mid August. However, the existing facility will be maintained operational as long as possible.

2.0 Crystal Growth and Crystallographic Characterization

Crystal growth during this quarter involved "routine" growth runs, and experimental growth runs attempting to utilize a curved melt configuration to enhance crystallinity.

2.1 Routine Growth Runs

A large number of (~30) samples were grown, from single crystal feedstock, in the 2:1 differential mode at a growth rate of 2" minute. The feedstock was 8 mils thick, the re-grown ribbon is 4.5 mils thick. The constant gradient furnace was used to reduce stresses in the ribbon samples during growth. The ribbon edges did not grow in a straight line (see Figure 5). The "serrated" edges were a result of an instability at the edges of the molten zone, which has only been observed when growing in the differential mode.

Figure 6 is a schematic of sample 369, which is typical of the whole run of samples. The sample was etched for 5 minutes in Wright etch in order

PHOTO SCALE

500μm

FIGURE 5. SAMPLE 351, West Edge

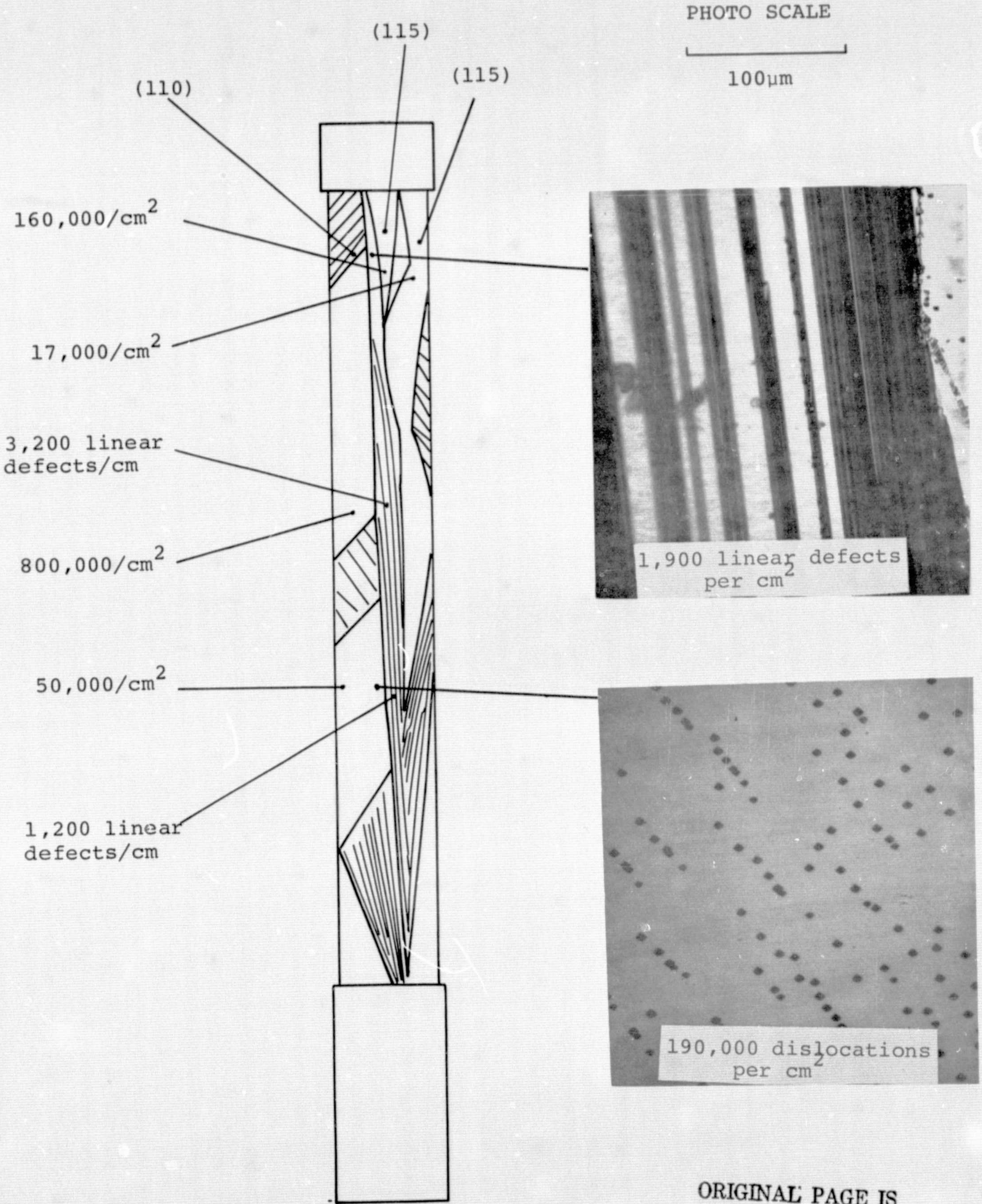


FIGURE 6. Sample 369

to delineate the twin planes, grain boundaries and dislcoations. The dislocation density ranged from 50,000 dislocations/cm^2 to 1.2 x 10^6 dislocations/cm^2. The linear defect density ranged from 1,000 to 3,000 linear defects/cm. Thus, although the linear gradient furnace effectively reduced the macroscopic stress in the silicon ribbon, it has apparently had no significant effect on the ribbon defect density. The dominant grains at the end of the crystal growth had ~(110) and ~(115) orientations (See Figure 6).

A number of samples from these runs have been processed into solar cells and some characterization of cells has been completed on a few cells; this is reported below under material/devise measurements. (Section).

2.2 Curved Melt Growth

In order to attempt to achieve larger crystalline sizes, attempts were made to achieve a curved melt configuration. A simple method for achieving the required curved melt configuration. A simple method for achieving the required curved melt was conceived which did not require the complex, dual scanning (x-y), technique utilized in earlier experiments.

The method used to achieve the curved melt is depicted in Figure 7. A flat tungsten foil (≈.01" thick) was mounted in an optical mount, which happened to be available, which could compress the foil lengthwise in order to achieve a desired amount of buckling. The bent foil was mounted just prior to the ribbon and reflected the scanning laser beam at a grazing angle with some slight vertical deflection. The amount of curvature could be varied by buckling the beam greater or lesser amounts.

2.2.1 Growth Experiments

Numerous growth runs were made but even though the technique would appear simple, numerous problems prevented us from achieving any samples worthy of further characterization.

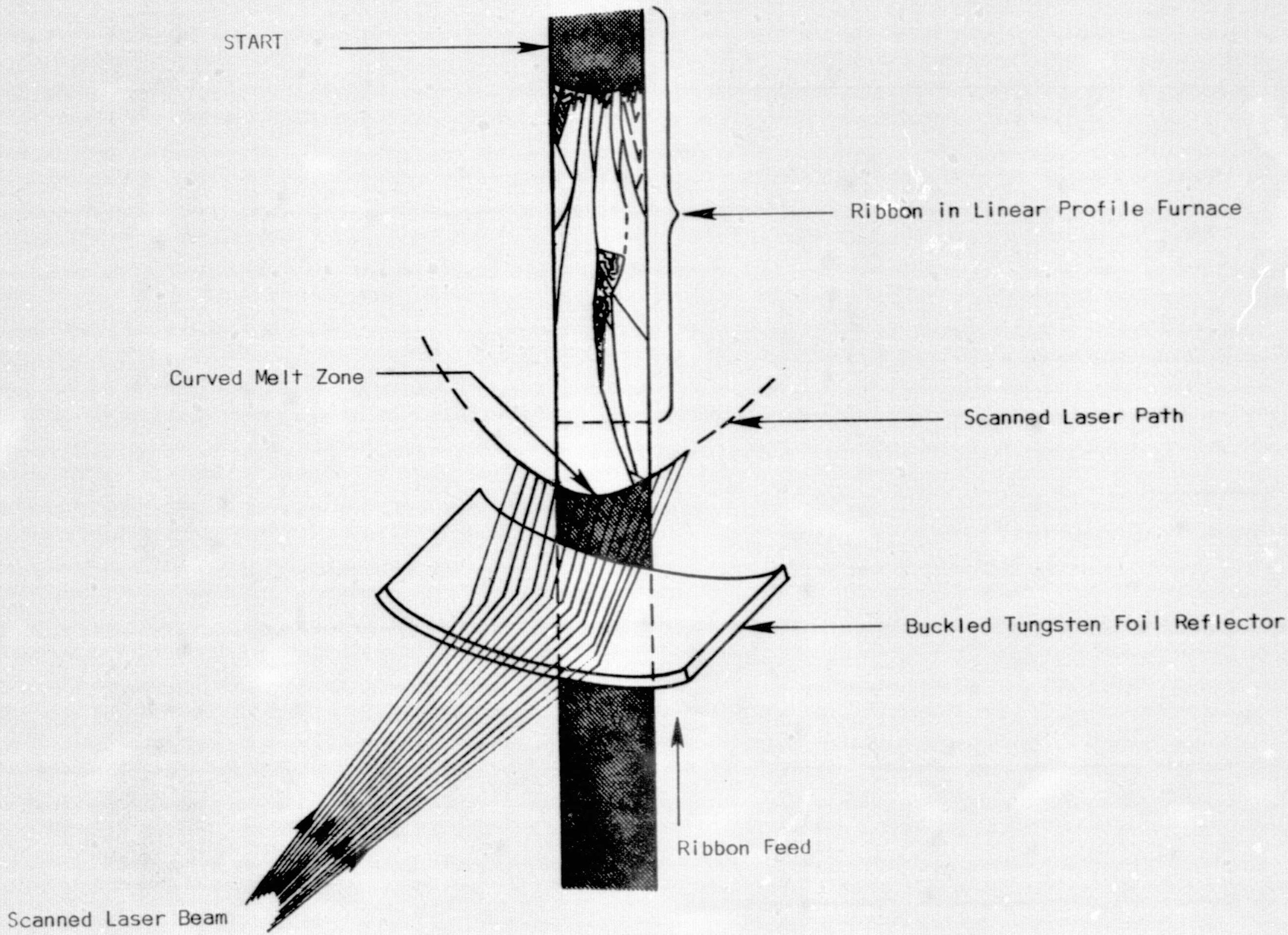


Figure 7: Method Utilized to Achieve a Curved Melt Zone for RTR Growth

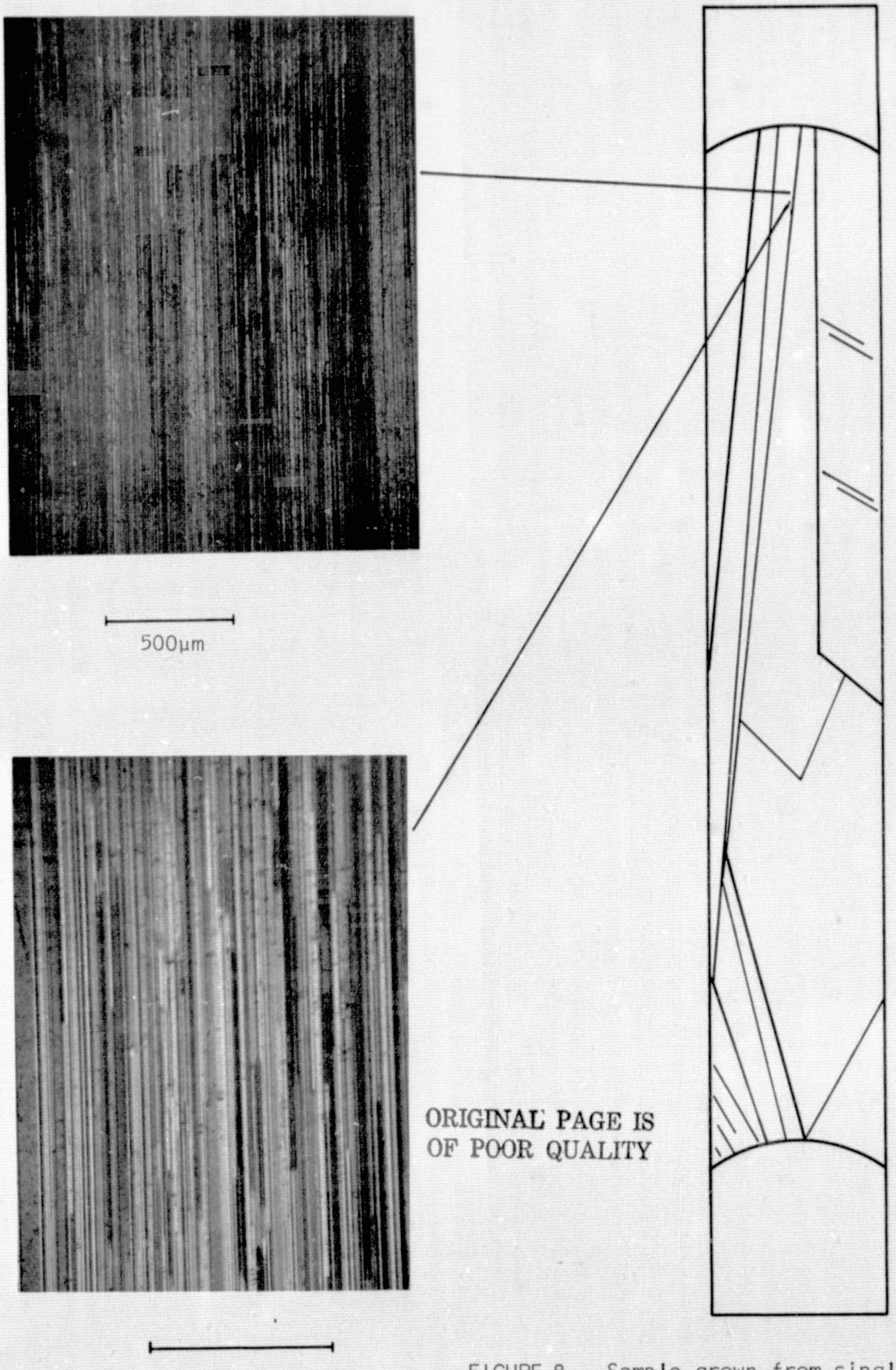


FIGURE 8 Sample grown from single crystal feedstock using a curved molten zone.

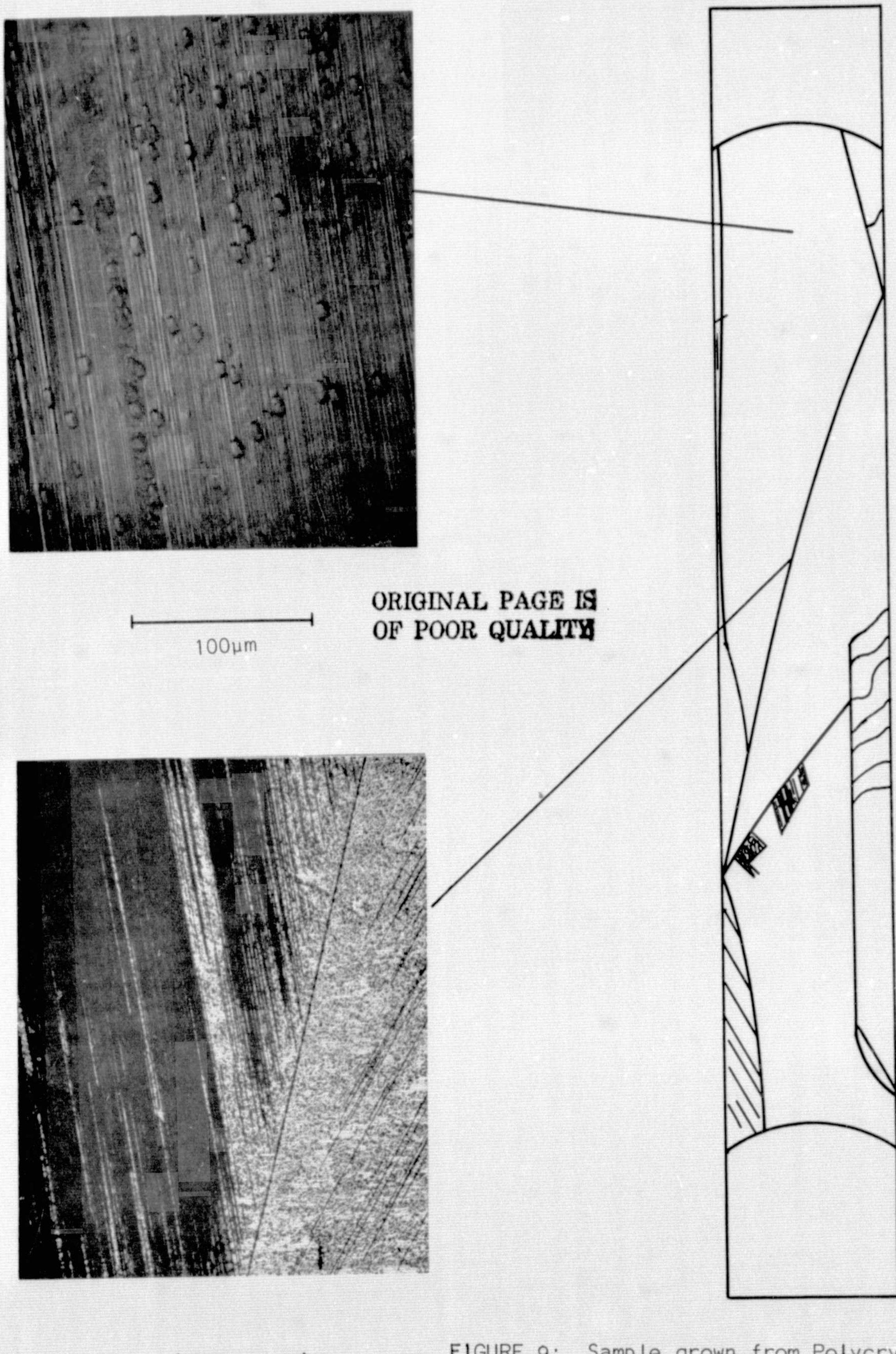


FIGURE 9: Sample grown from Polycrystalline feedstock using a curved molten zone.

One problem resulted from the particular curvature required for crystal size enhancement. As indicated in Figure 7, the beam must be deflected and curved in such a manner that the beam which continues past the silicon is now directed into the furnace. Space limitations prevent the reflector from being <u>above</u> the melt and deflecting <u>away</u> from the furnace. This beam which hits the furnace caused vaporization of a quartz muffle and insulation which would invariably get into the melt region giving very poor looking ribbons.

In order to attempt to prevent the beam from entering the furnace, platinum shields were fashioned around the entrance slot. However this was not altogether successful either as the beams were still able to enter the furnace through multiple reflections from the furnace. A proper shield will require rather critical sizing in order that the ribbon may pass through the slot without touching the ribbon but yet prevent the upward deflected beam from entering the furnace. As a means to temporarily solve the problem the melt was allowed to occur further from the furnace entrance but this has resulted, so far, in increased stress and large edge and surface distortions.

2.2.2 Results

Some curved melt growth runs were moderately successful. Examples of samples grown at 1"/min. from polycrystalline feedstock (sample 417) and single crystal (110) [100] feedstock (sample 423) are shown in Figure 8 and 9, respectively. The orientation of the large grain produced in sample 417 is ~(213) [253], and the large grain in sample 423 is (113) [301]. This latter orientation has occurred frequently in earlier samples.

For comparison, a number of samples were grown at 1"/min. from polycrystalline feedstock using a <u>flat</u> molten zone. Figure 10 is a schematic of sample 464, which was typical of this series. Laue photographs taken at the points marked × in Figure 10 all showed roughly the (110) [112]

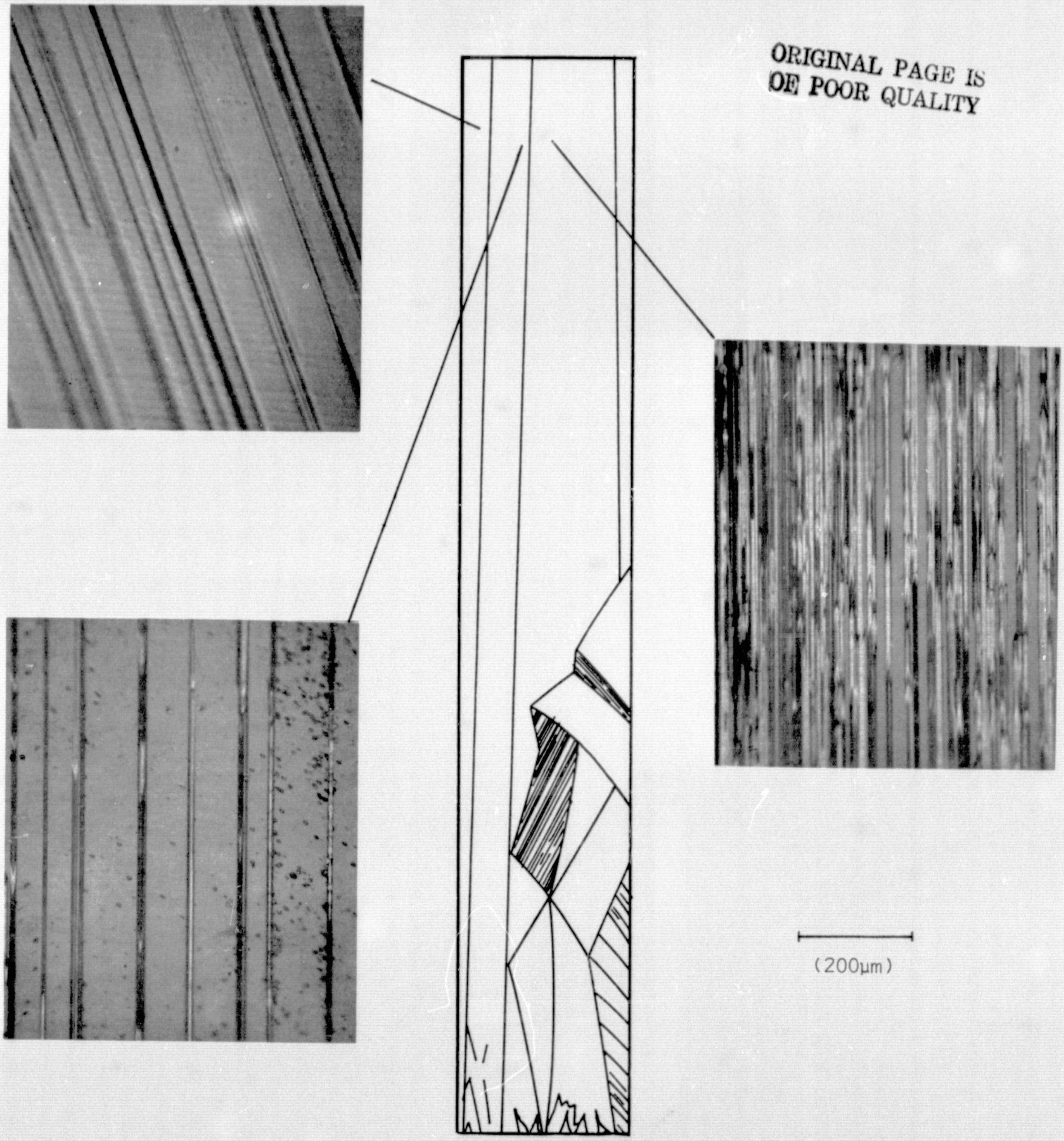


FIGURE 10 SAMPLE 464 - GROWTH FROM POLYCRYSTALLINE FEEDSTOCK USING A FLAT MOLTEN ZONE

orientation. Other dominant grains observed on samples grown from poly feedstock using a flat molten zone include ~(211) [022]; ~(552) [$\bar{1}$11]: ~(123) [2$\bar{1}$0].

In the majority of samples the large grains are actually composed of a high density, very fine twin bundle structure. The samples shown in Figures 8, 9, and 10 were Wright etched to delineate their grain boundaries.

3.0 Material/Device Characterization

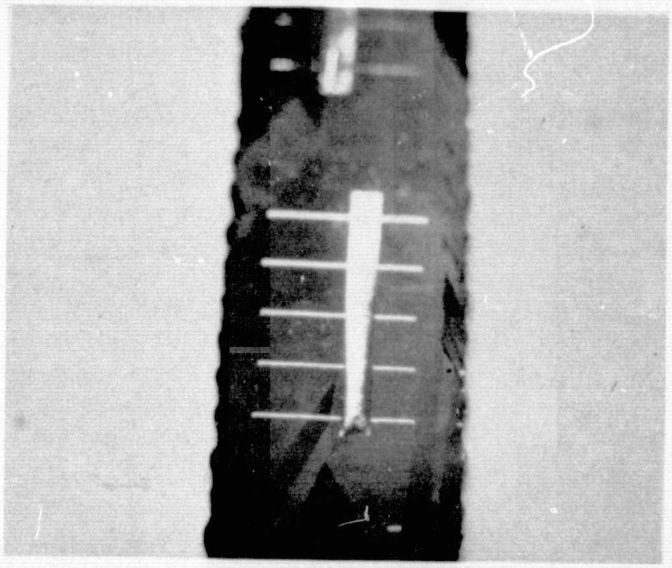
3.1 Solar Cells

Samples submitted to the solar cell processing area have offered some difficulties during late photoresist steps, but a few ribbons have been completed. Evaluation of these first solar cells, the first completed since the addition of the linear profile furnace and attainment of higher growth velocities (2"/min.), shows substantial improvement in performance over previous cells. Even of the few ribbons completed, several of the test cells exhibited metallization shorts due to photoresist problems. The best control sample and the best ribbon of this first group have been evaluated. Figure 11 shows a photo of the ribbon sample evaluated. Figures 12 and 13 show load plots for the cells which have been normalized to active area; excluded the large "bar" center contact.

As can be seen from Figure 12, the measured efficiency is just over 10%; this represents the best cell so far on RTR. The control cell (Figure 13) exhibited an efficiency of 12.4%. Figures 14 and 15 are spectral response plots for these same cells; from these we see evidence not only of losses in the long wavelength portion of the spectrum, as expected for the short diffusion lengths measured on RTR ribbons, but also significant losses in the short wavelength regime. This most likely points to a junction depth problem. Since, as Figure 11 shows, multiple orientations occur in the cell, variations in junction depth might occur due to the various orientation, but may also occur along grain boundaries. Sectioning will be performed on typical cells to attempt to indicate the short wavelength degradation.

SAMPLE #355

EFFECTIVE CELL AREA $1.1cm^2$



1cm

FIGURE 11: RIBBON SOLAR CELL

RIBBON SOLAR CELL

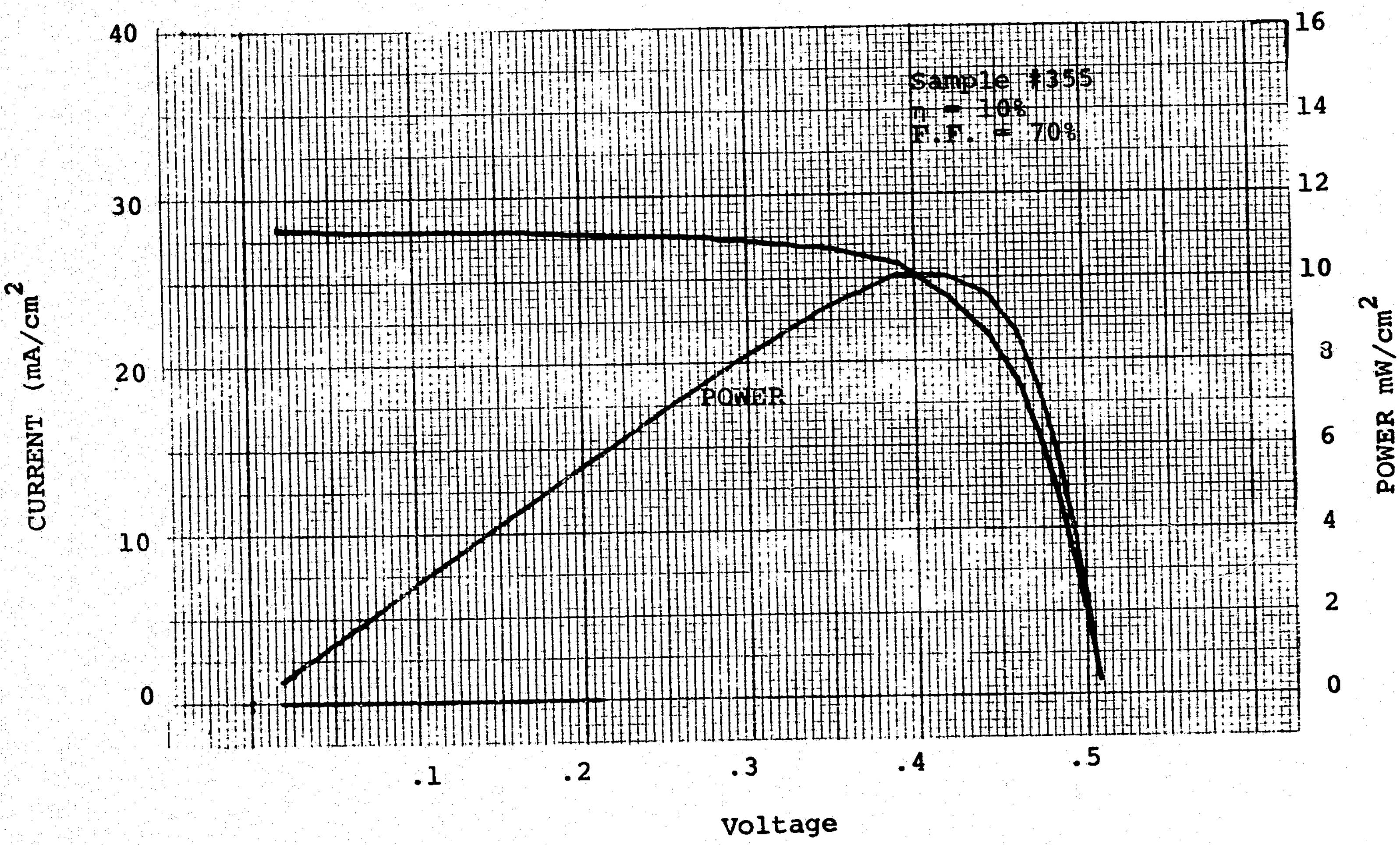


FIGURE 12: LOAD CURVE OF SOLAR CELL

CONTROL SOLAR CELL

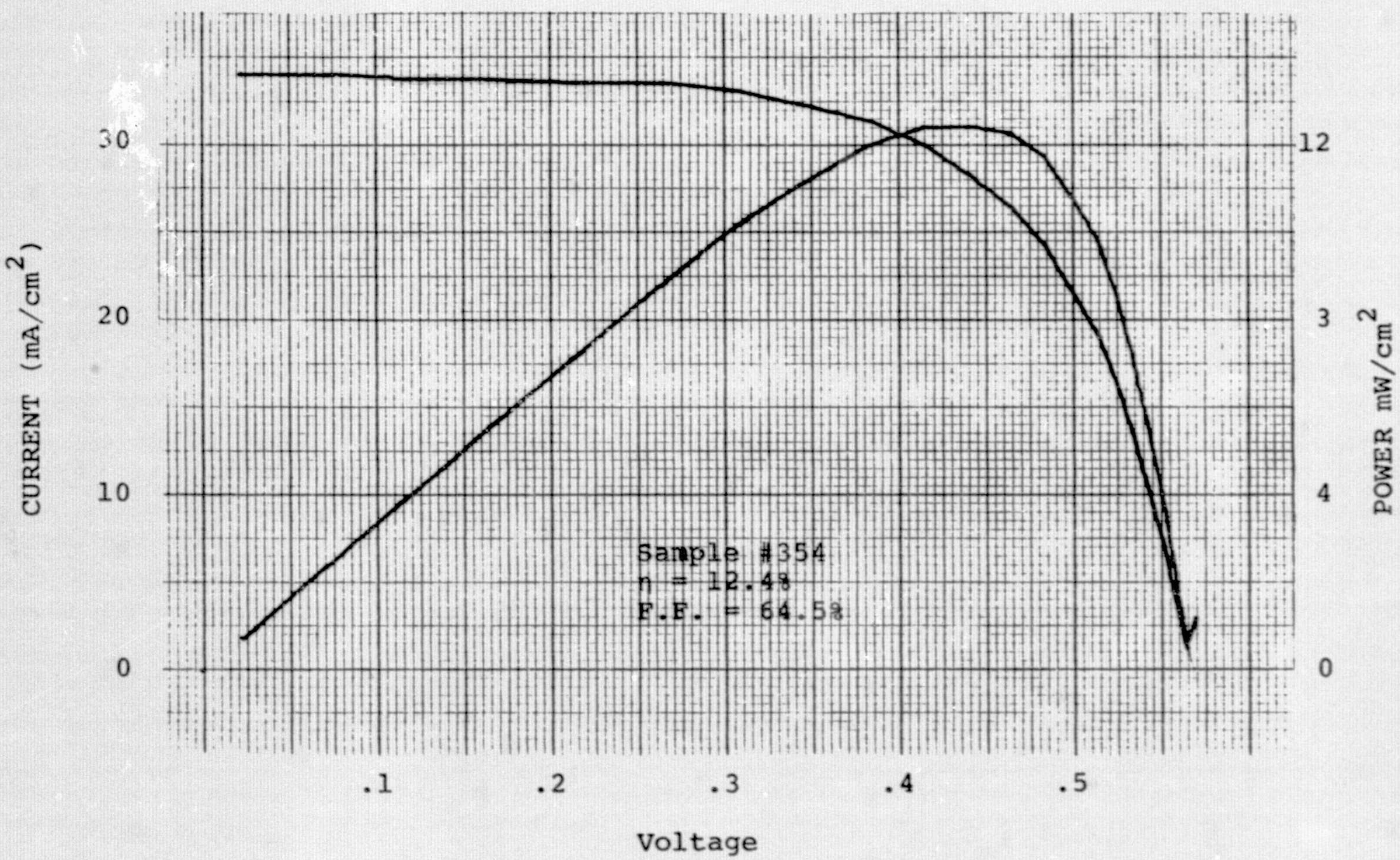


FIGURE 13: LOAD CURVE OF CONTROL CELL

SPECTRAL RESPONSE (RIBBON)

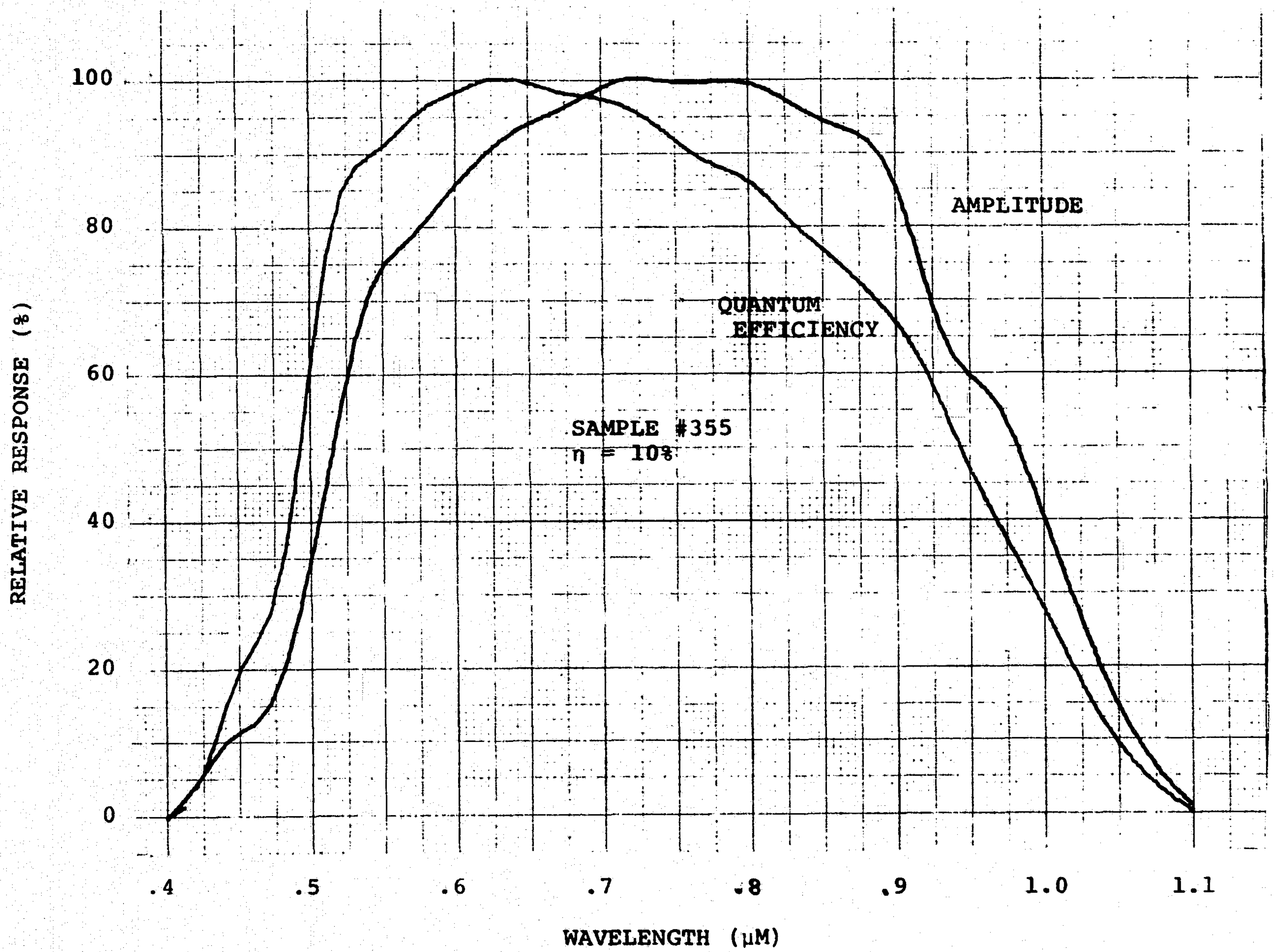


FIGURE 14: SPECTRAL RESPONSE (RIBBON)

SPECTRAL RESPONSE (CONTROL)

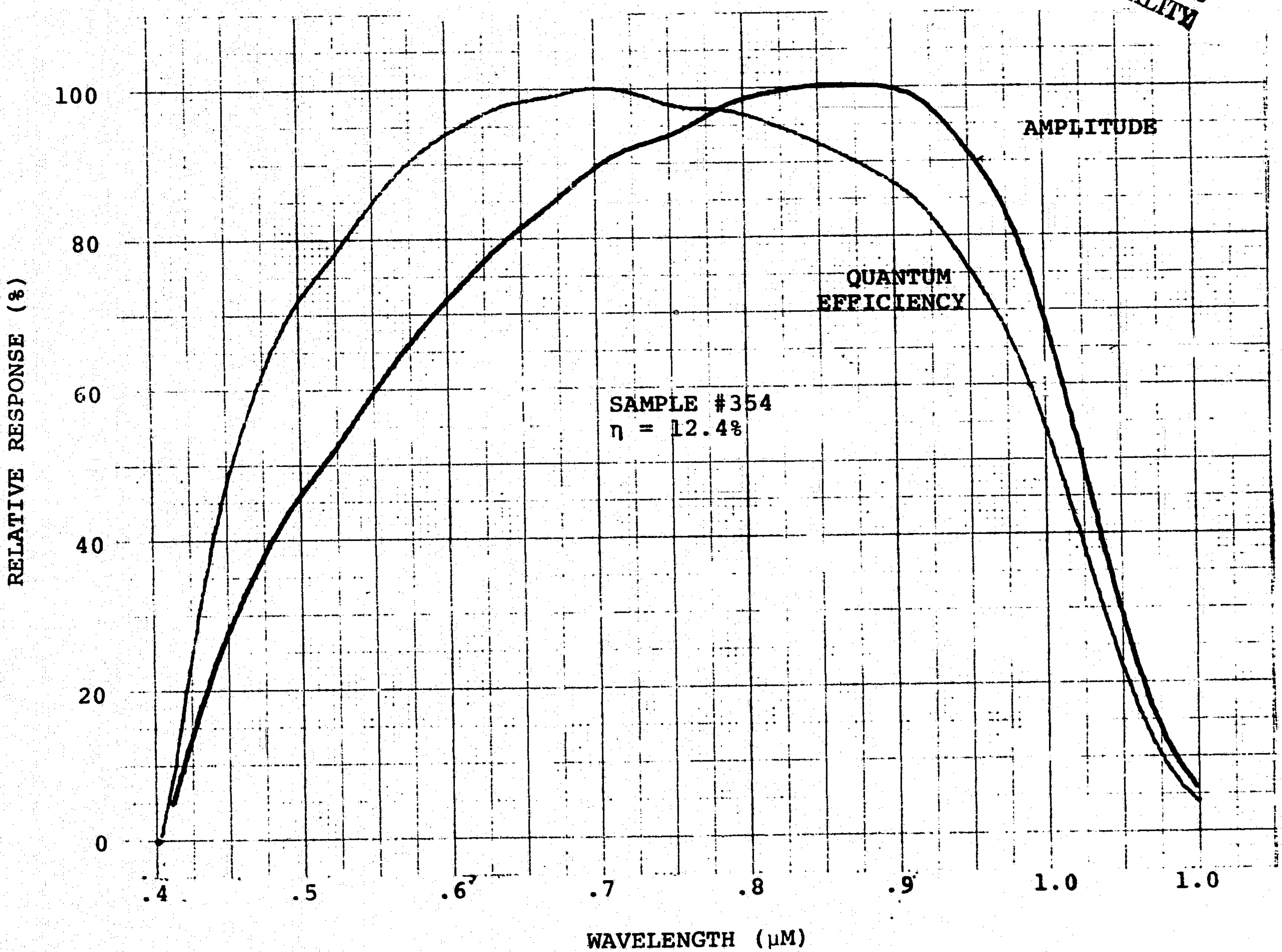


FIGURE 15: SPECTRAL RESPONSE (CONTROL)

SPV measurements have also been performed on the ribbon and control cell. These were performed using the open circuit voltage of the cell as the "surface" voltage. The diffusion length measured on the control cell was about 100µm. Figure 16 shows results of measurements on the ribbon cell at various points. A light spot of about 1.5mm in diameter was used. Note that the values given (28-38µm) are significantly higher than the 10-15µm values measured prior to processing. No real correlation with the presence of grain boundaries is noted but some orientation dependence might be evident.

Both the control and ribbon cell were measured under "one sun" conditions and dark conditions; virtually no effect was noted on measured diffusion lengths in contrast to reports by Tyco.

3.2 SPV Studies

The light level dependence of SPV measurements has been a concern to us for both measurements on standard crystals as well as for ribbon. Tyco has reported an increase in diffusion length with illumination level for short circuit current analysis of ribbon solar cells while little dependence was shown for Czochralski cells. The conventional SPV method for substrate evaluation utilizes considerably lower light levels than "one sun" for its measurement and brings into question its value for solar cell material evaluation. Choo and Sanderson* have analyzed the effects of traps on measured diffusion lengths by the SPV method. Their conclusion was that under most conditions of minority carrier trapping, the measured diffusion length will be longer than one without shallow traps. This has been observed in measurements on some single crystal samples. One example may be cited. A Wacker, p type 1.9Ωcm, crystal, float zone, was measured in the dark with a diffusion length and lifetime of 500µm and 125µsec respectively. Illumination of the back surface of the 15 mil thick sample

*S.C. Choo and A.C. Sanderson, Solid State Electronics, 13, pp. 609-617

OPEN CIRCUIT PHOTOVOLTAGE
DIFFUSION LENGTH MEASUREMENTS

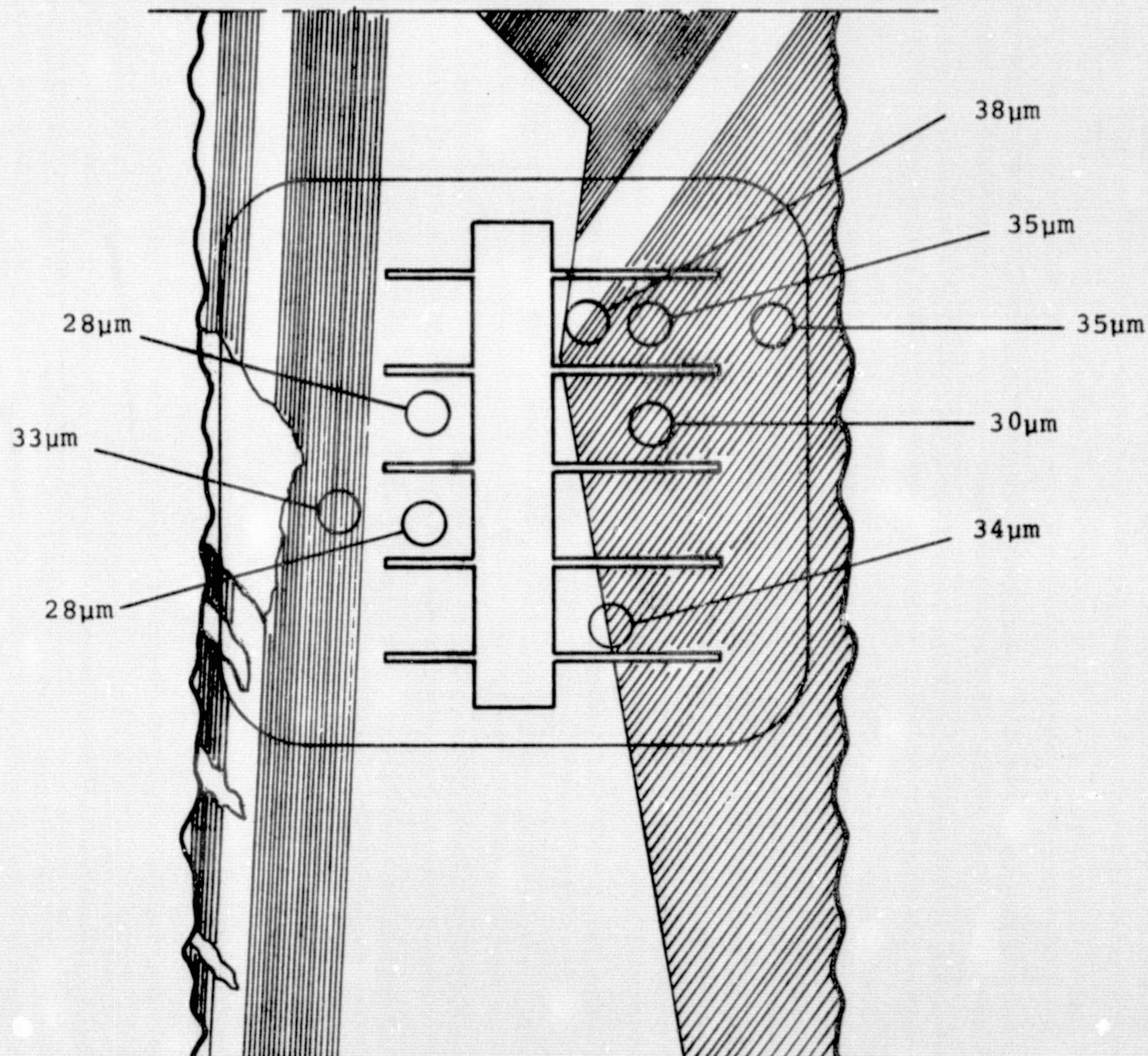


FIGURE 16: SPV ON RIBBON CELL

at a light level of ~.01 suns yielded values of 160μm and 12.8μsec -- more typical of 1.9Ωcm material.

These effects need (and will receive) more study to ascertain what might be the proper conditions for measurement. In addition, some effort is also underway to obtain a low temperature Schottky barrier solar cell structure which will allow SPV-like measurements to be made at high ambient illumination without the problem of saturation of the photovoltage. In this regard, In-Sn-O transparent electrodes were sputtered onto a sample in an attempt to make Schottky solar cells. This was successful but good SPV measurements have not yet been made in this manner. Reflectivity corrections need to be made and this might be a source of some of the problem.

3.3 SPV Material Studies

While many authors have reported on the variation of lifetime due to dislocations, oxygen precipitation, point defects clustering, etc., it is still not clear which mechanism is primarily contributing to the lifetime degradation observed in RTR growth (maybe all of them).

Since RTR ribbons definitely exhibit large variations in dislocation densities and undergo rapid variations in temperature, some experiments were performed to simulate these conditions without actual crystal growth.

In addition these experiments were intended to evaluate the performance of our linear profile furnace for preventing and/or relieving stresses.

3.3.1 Experiment Description

Figure 17 shows a flow chart for the experiment now in progress. Czochralski and float zone wafer samples are prepared by cutting to 2cm wide ribbon-like samples. Some samples are gettered using a phosphorous getter technique while others are not gettered. Control sections are

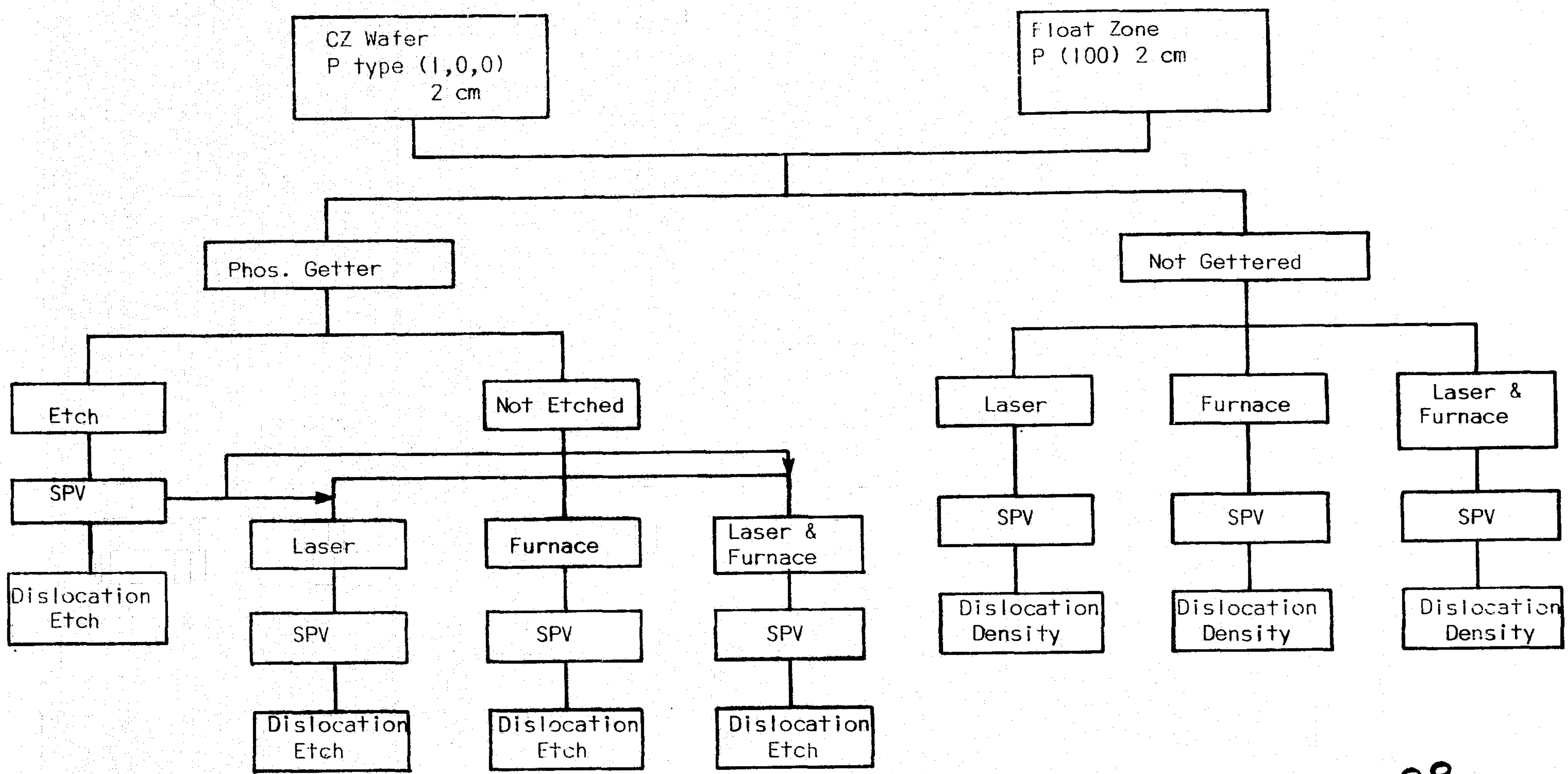


FIGURE 17 Flow Chart for Stress - Gettering Experiments

retained for each wafer which experience no processing. SPV measurements are made for lifetime evaluation at various stages of the experiment.

Ultimately, each sample is to experience three thermal environments: 1) a stationary laser melt for one minute and then cooled rapidly, 2) insertion into the linear profile furnace at 1"/min. from the "cold" side until totally within the furnace, held stationary for one minute and then withdrawn at 1"/min., and 3) a combination of 1) and 2). Figure 18 shows the temperature profiles expected for the laser and furnace along the sample; depending on the experiment, one or the other, or both of the temperature contributions would exist.

If the furnace had an ideal thermal profile, it would be hoped that process 2) would cause no stresses and therefore low dislocation densities but would nevertheless experience a temperature profile. Process 1) would exhibit the worst thermal environment while process 3) would in some way (not very well though) approximate growth conditions.

3.3.2 Results

The experiment is only partly completed at this time but some observations have been made already:

- Temperatures and dislocation densities similar to RTR growth conditions, but not involving regrowth, result in similar diffusion lengths to those of ribbons.
- The linear profile furnace (as profiled for these experiments) did not relieve or prevent stresses either due to its own heat or due to the laser and furnace environment.

LASER/FURNACE TEMPERATURE PROFILES

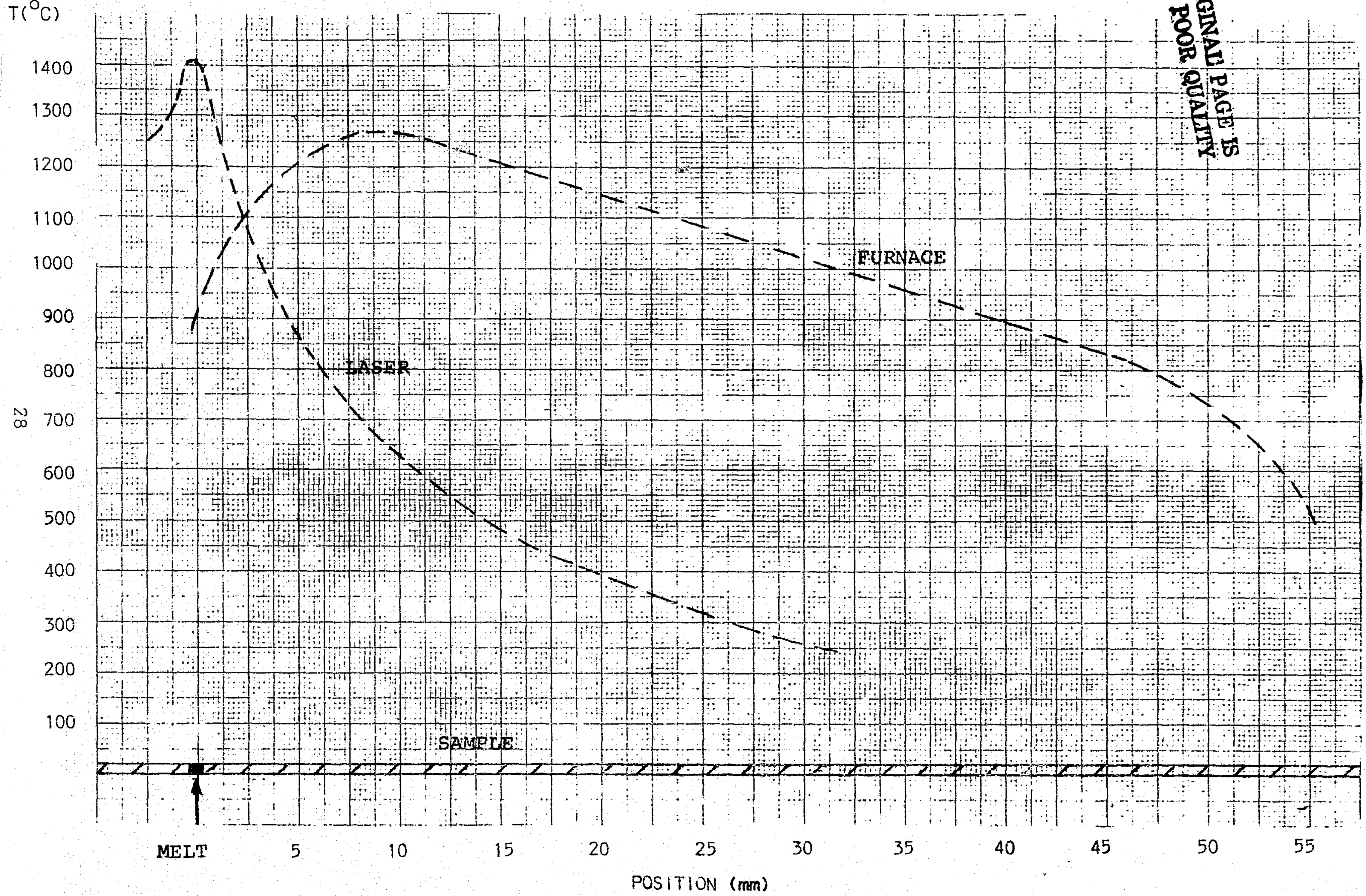


FIGURE 18: THERMAL PROFILES

"LASER ONLY" EXPERIMENTAL RESULTS

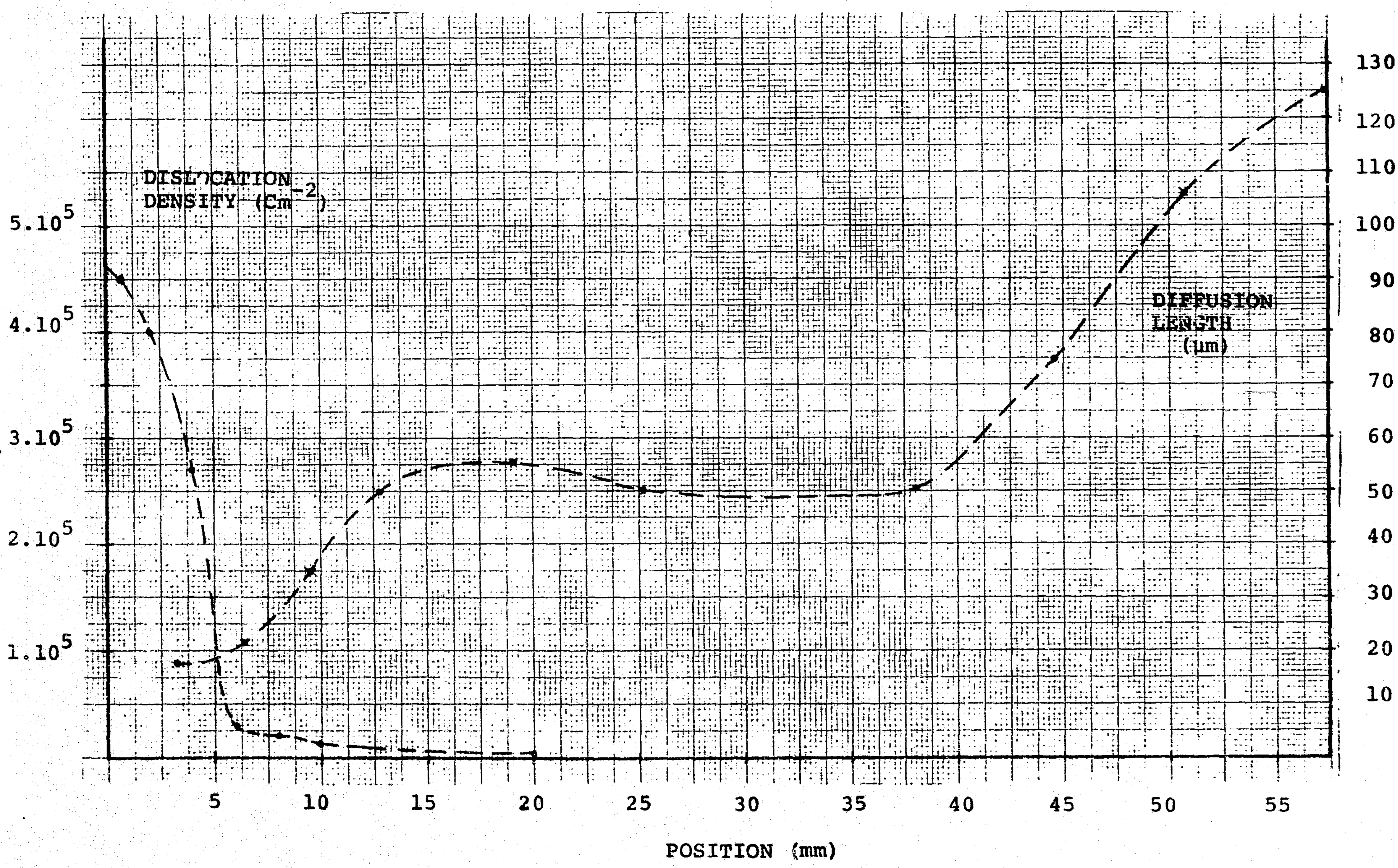


FIGURE 19: LASER ONLY: DISLOCATION AND SPV

- Dislocation densities similar to that of the worst regions of RTR ribbons can be generated in single crystal material even with the furnace. Consequently, at present, stress relief is being effected but stress prevention is not.
- Even relatively low temperatures (≈700°C) cause significant reductions in lifetime.

Figure 19 is an example of a "laser only" experiment. Dislocations are generated near the melt but rapidly disappear with distance from the melt. Figure 19 also indicates diffusion length measurements at corresponding points of the sample. Note the correlation of very short diffusion lengths with dislocaiton density but then a plateau of reduction occurs well beyond observation of dislocations. This region, would have encountered high temperatures, but mostly below 700°C; only where the sample was clamped are the intial diffusion lengths of 90-110μm approached.

Figure 20 illustrates a "laser + furnace" experiment. Note the peak in dislocations at a point between the laser melt and the furnace peak; this is intuitive if one expects a tempeature dip between the furnace and laser melt region - this would be a maximum stress region. Dislocations occur for some distance from the melt also since stress relief can occur over a greater distance due to the higher temperatures. Figure 20 again also illustrates diffusion lengths for this sample. Again, significant degradation occurs even in areas free of dislocations but experiencing high temperatures.

Figure 21 exhibits the stresses, measured by birefringence analysis, across the sample at the point of maximum dislocations. On the same figure is a plot of the measured dislocations densities across the sample; the correlation is evident: maxima of residual stresses corresponds to maximum stress relief (generation of dislocations) at higher tempeatures.

"LASER PLUS FURNACE" EXPERIMENTAL RESULTS

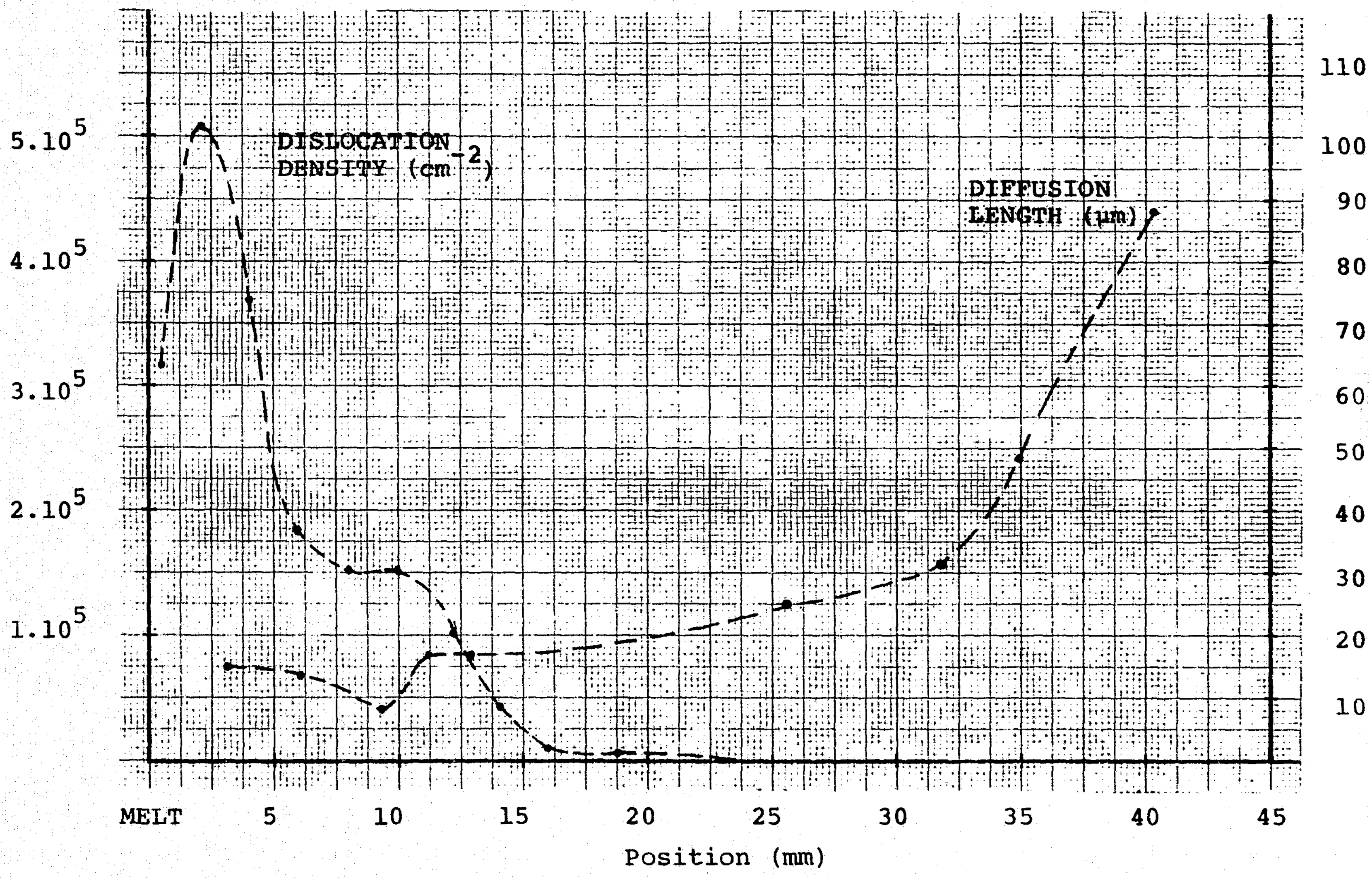


FIGURE 20: LASER & FURNACE -- DISLOCATIONS AND SPV

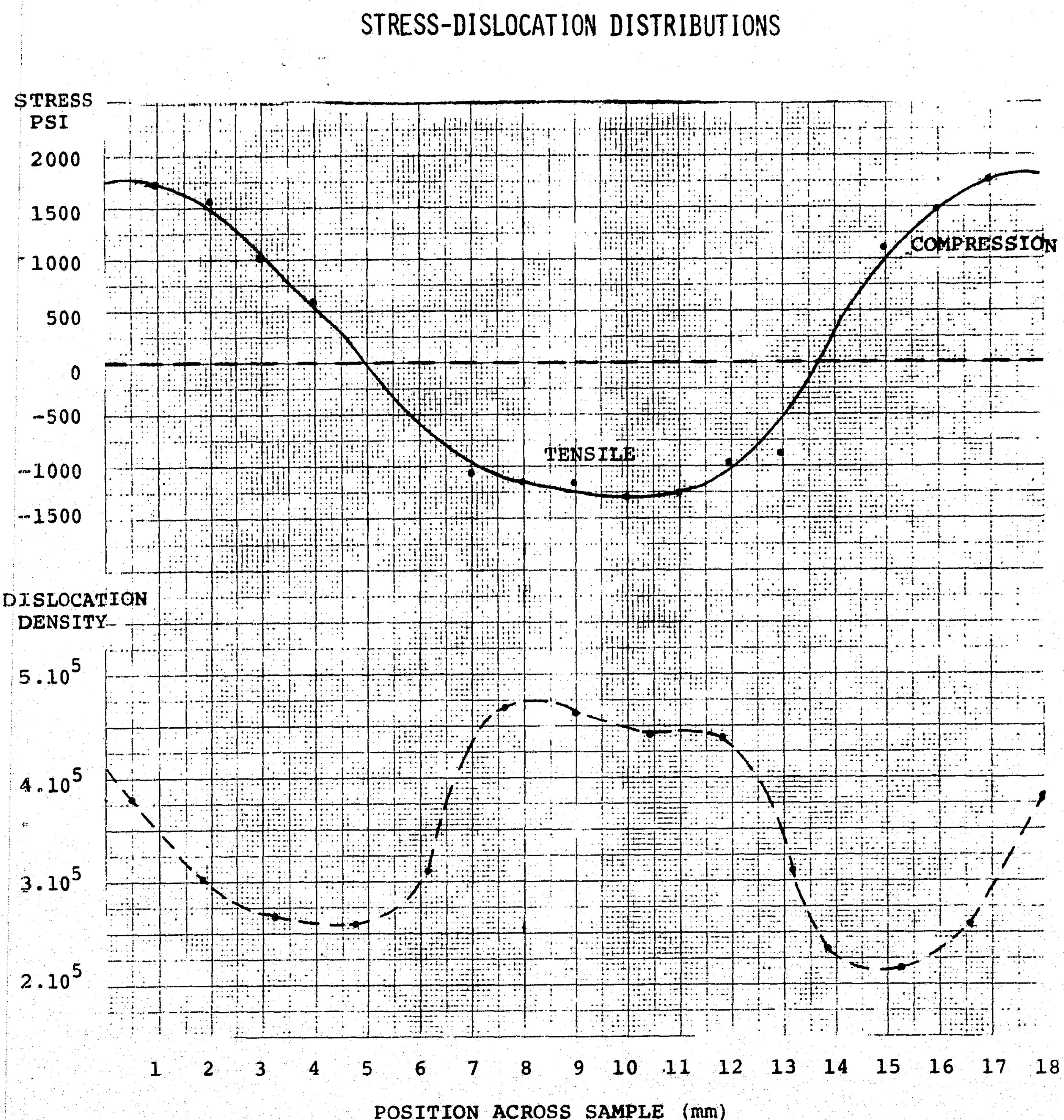


FIGURE 21: STRESS DISLOCATION CORRELATION

4.0 PROBLEMS

No problems limiting progress are apparent at present.

5.0 PLANS

Fabrication, assembly and testing of various components of the new RTR apparatus will continue during the first portion of the next quarter with actual operations beginning in mid August. Once operations of the RTR #2 apparatus have begun, efforts will be made to compare perfromance of the two laser systems and to achieve new levels of performance. Attempts will be made to grow wide (5 - 7.5 cm) samples at high velocities in order to ascertain the nature of growth limitations for the new appartus.

Theoretical and experimental stress analyses will continue. Various thermal profile modification techniques will be modeled and attempts made to attain lower residual stresses and reduce dislocation densities. Characterization of ribbons and fabrication of solar cells will continue with increased emphasis on analysis and process development for increased solar cell efficiency.

6.0 NEW TECHNOLOGY

No new technology items were uncovered during this report period.

7.0 PROGRAM EXPENDITURES

The following are the manhours and costs expended in the performance of the program through the month of May.

1. MANHOURS

Previous Expenditures	Current Expenditures	Cumulative Expenditures
9379	974	10353

2. FUNDS

Previous Expenditures	Current Expenditures	Cumulative Expenditures
372898	42050	414948

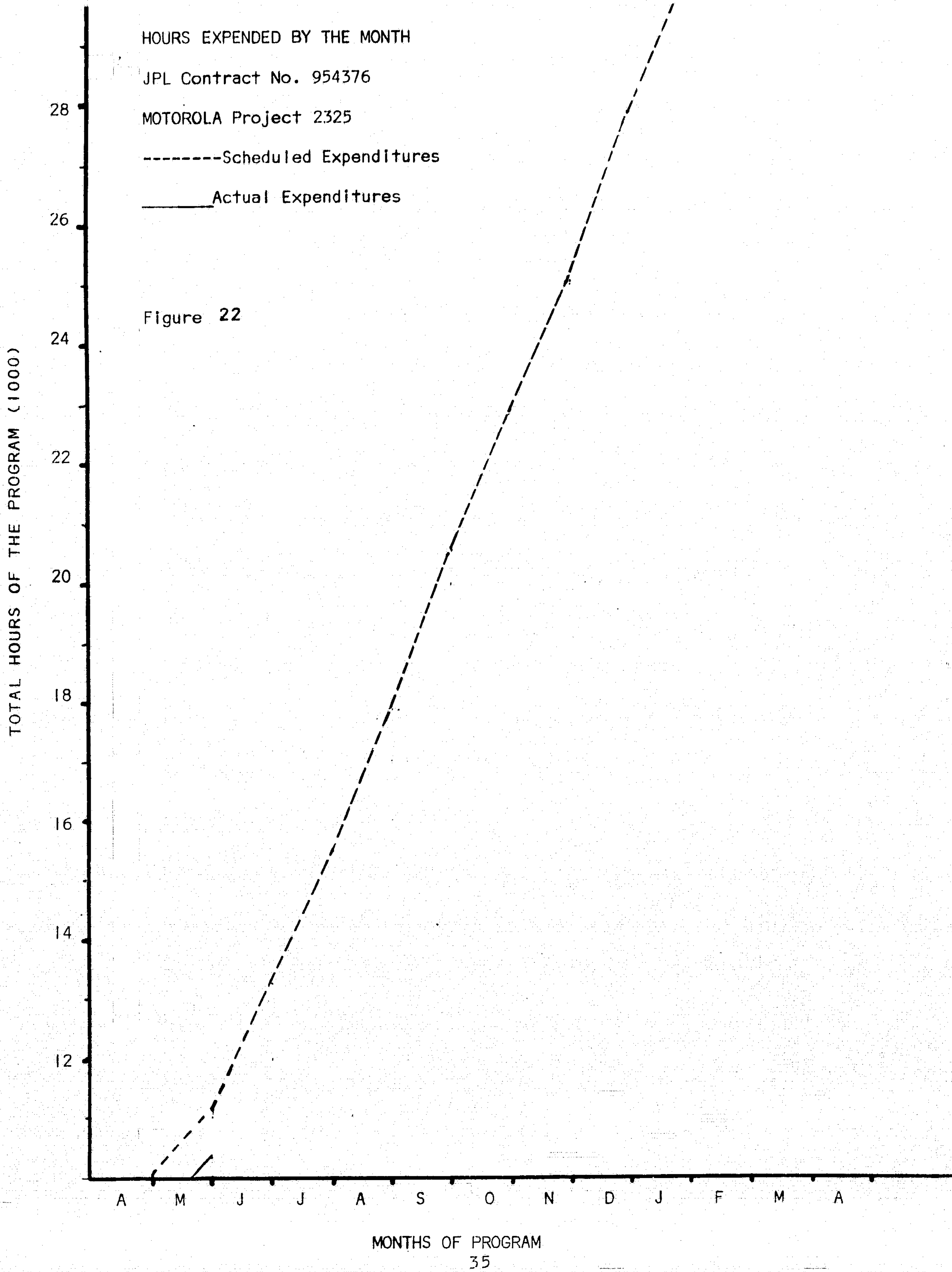
Figures 22 and 23 depict graphically the hours and costs expended by month.

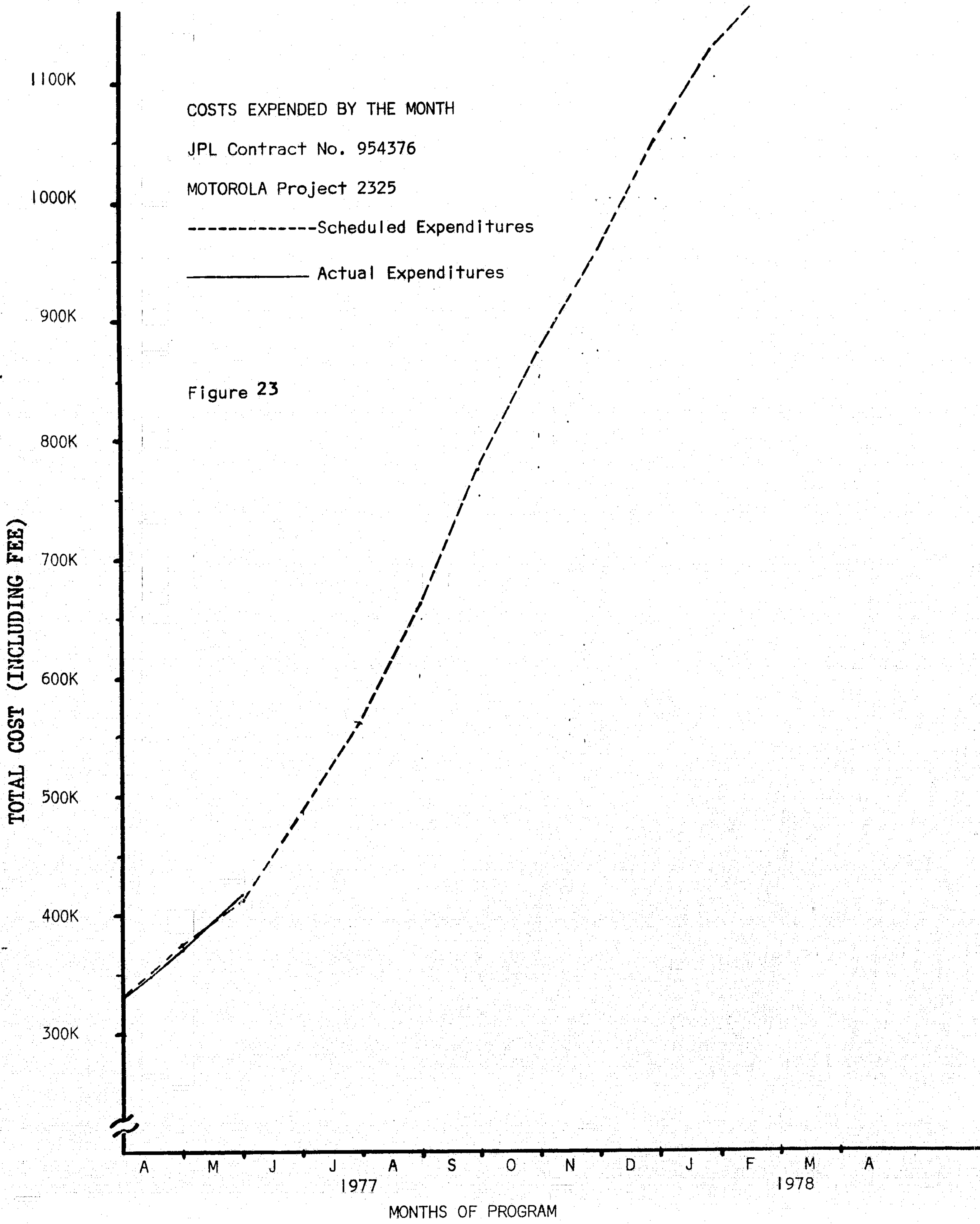
8.0 MILESTONES

Activities associated with the total program are shown in the Milestone Chart Figure 24.

9.0 ENGINEERING DRAWINGS

Included in the appendix are drawings of the improved ribbon transport stage and preliminary drawings of components for the RTR apparatus.


HOURS EXPENDED BY THE MONTH
JPL Contract No. 954376
MOTOROLA Project 2325
--------Scheduled Expenditures
_______Actual Expenditures
Figure 22
TOTAL HOURS OF THE PROGRAM (1000)
28
26
24
22
20
18
16
14
12
A M J J A S O N D J F M A
MONTHS OF PROGRAM


COSTS EXPENDED BY THE MONTH
JPL Contract No. 954376
MOTOROLA Project 2325
-------------Scheduled Expenditures
Actual Expenditures
Figure 23
TOTAL COST (INCLUDING FEE)
1100K
1000K
900K
800K
700K
600K
500K
400K
300K
A
M
J
J
A
S
O
N
D
J
F
M
A
1977
1978
MONTHS OF PROGRAM

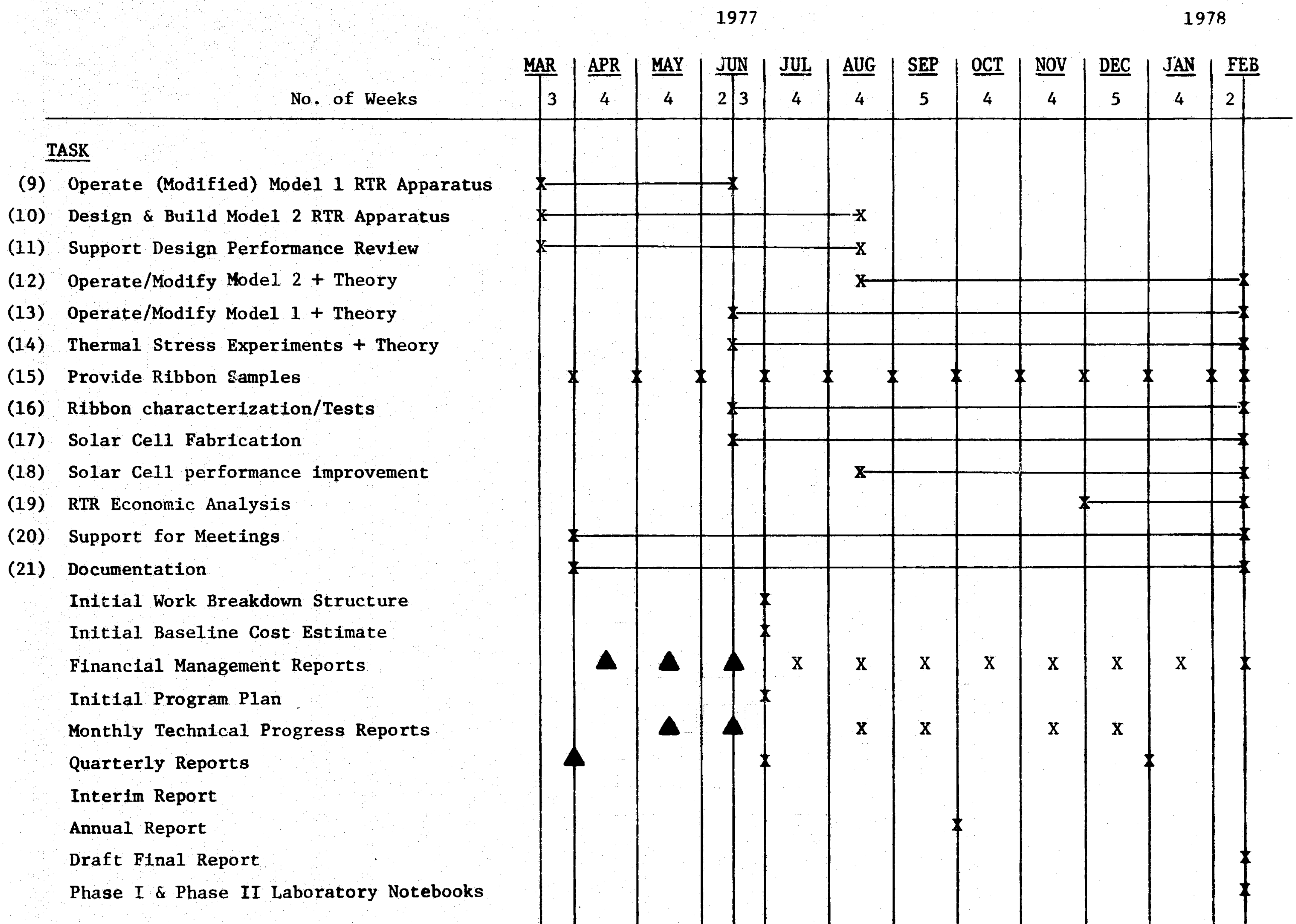
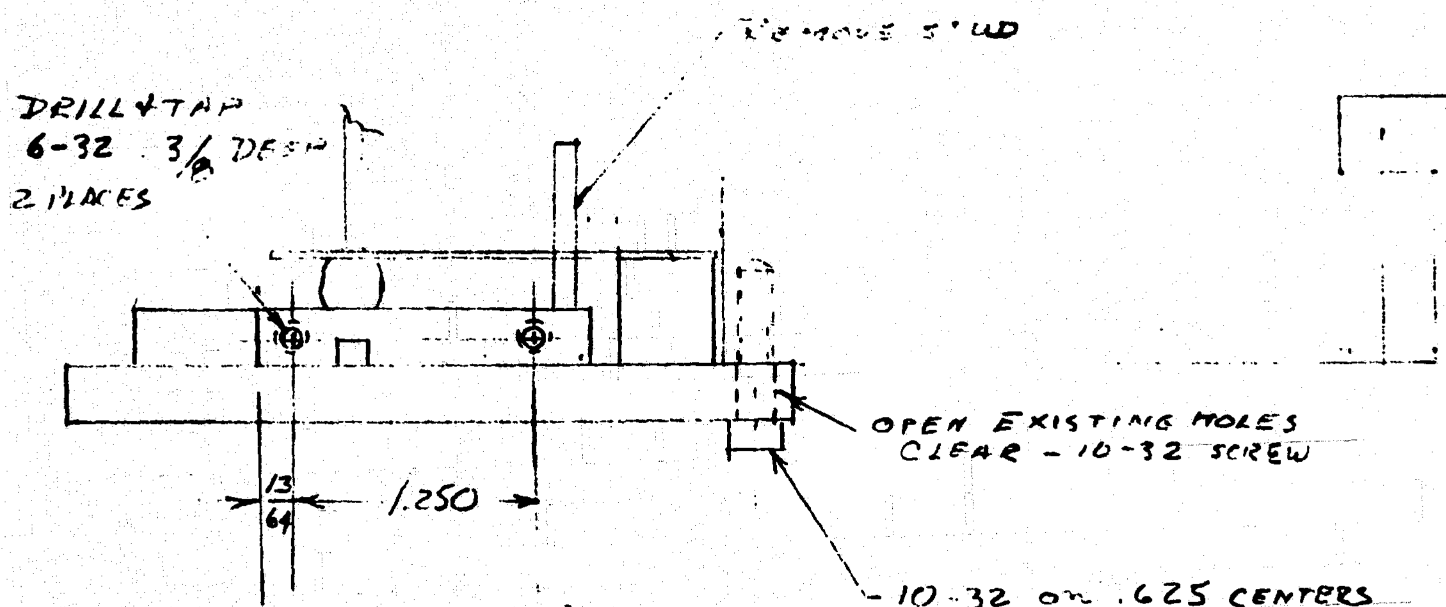


Figure 24 - Milestone Chart

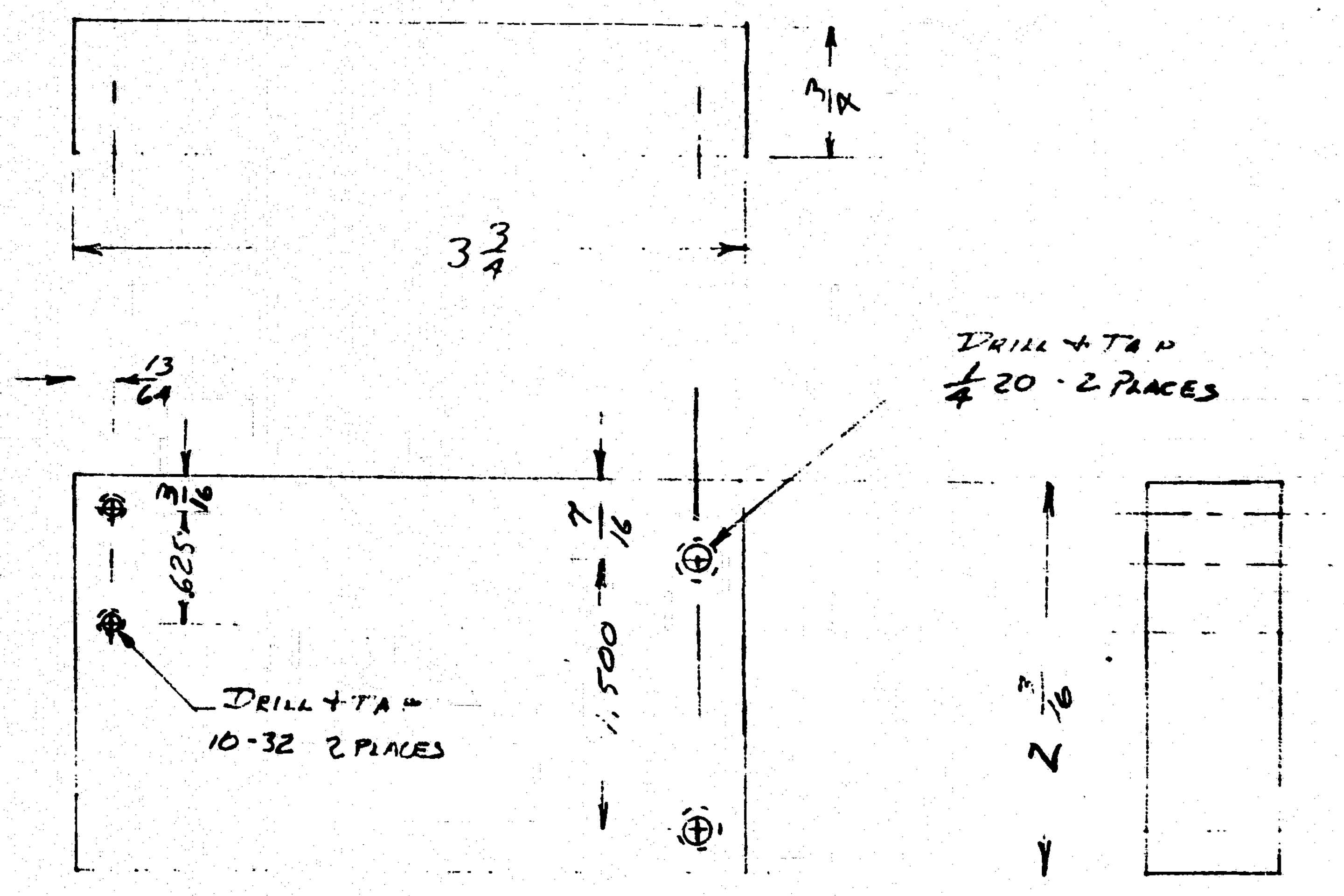
ENGINEERING DRAWINGS



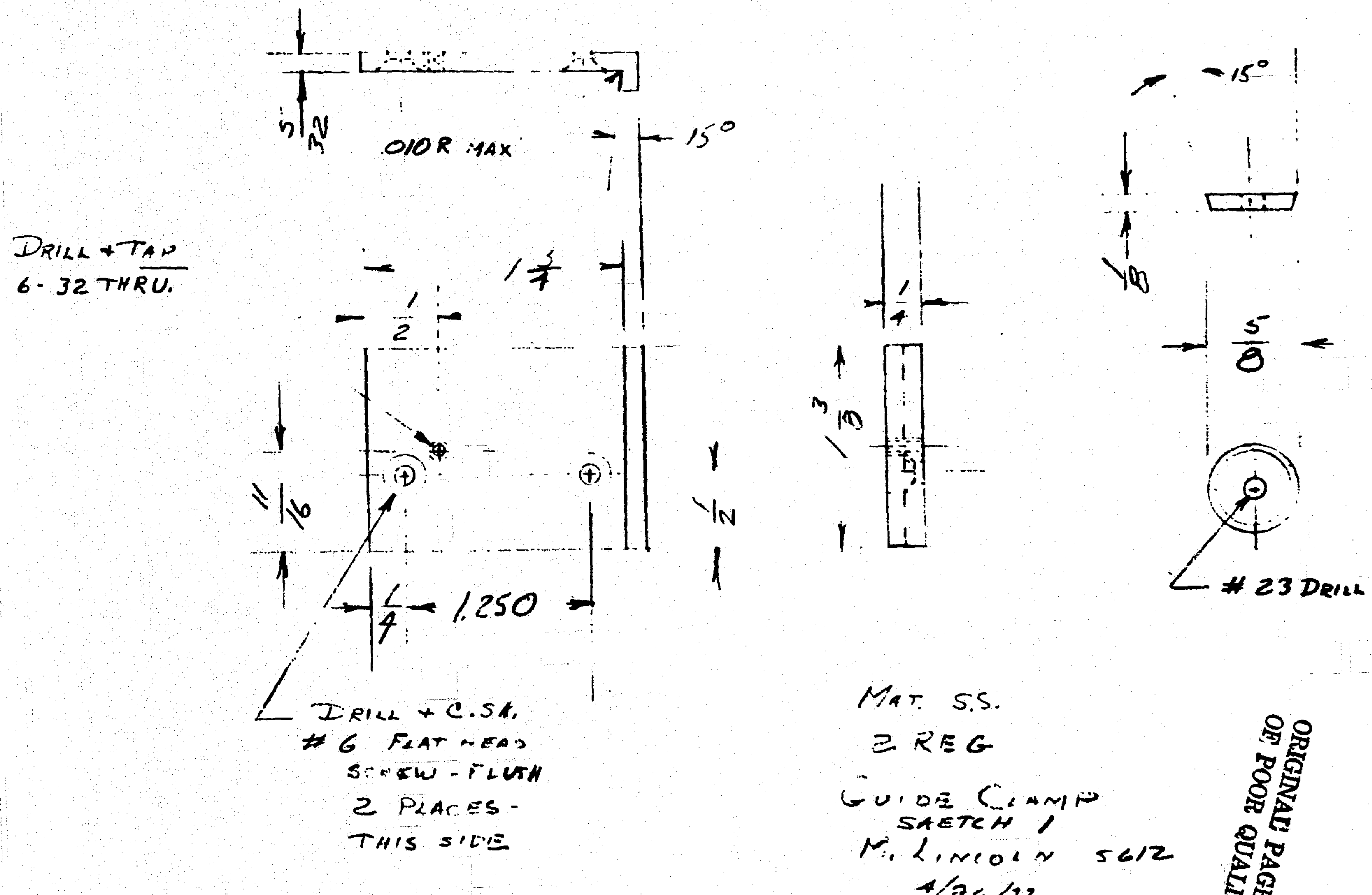
EXISTING PROBE
ALLEN BENJAMIN MPIA 062
MODIFY AS SHOWN

2 REQ.

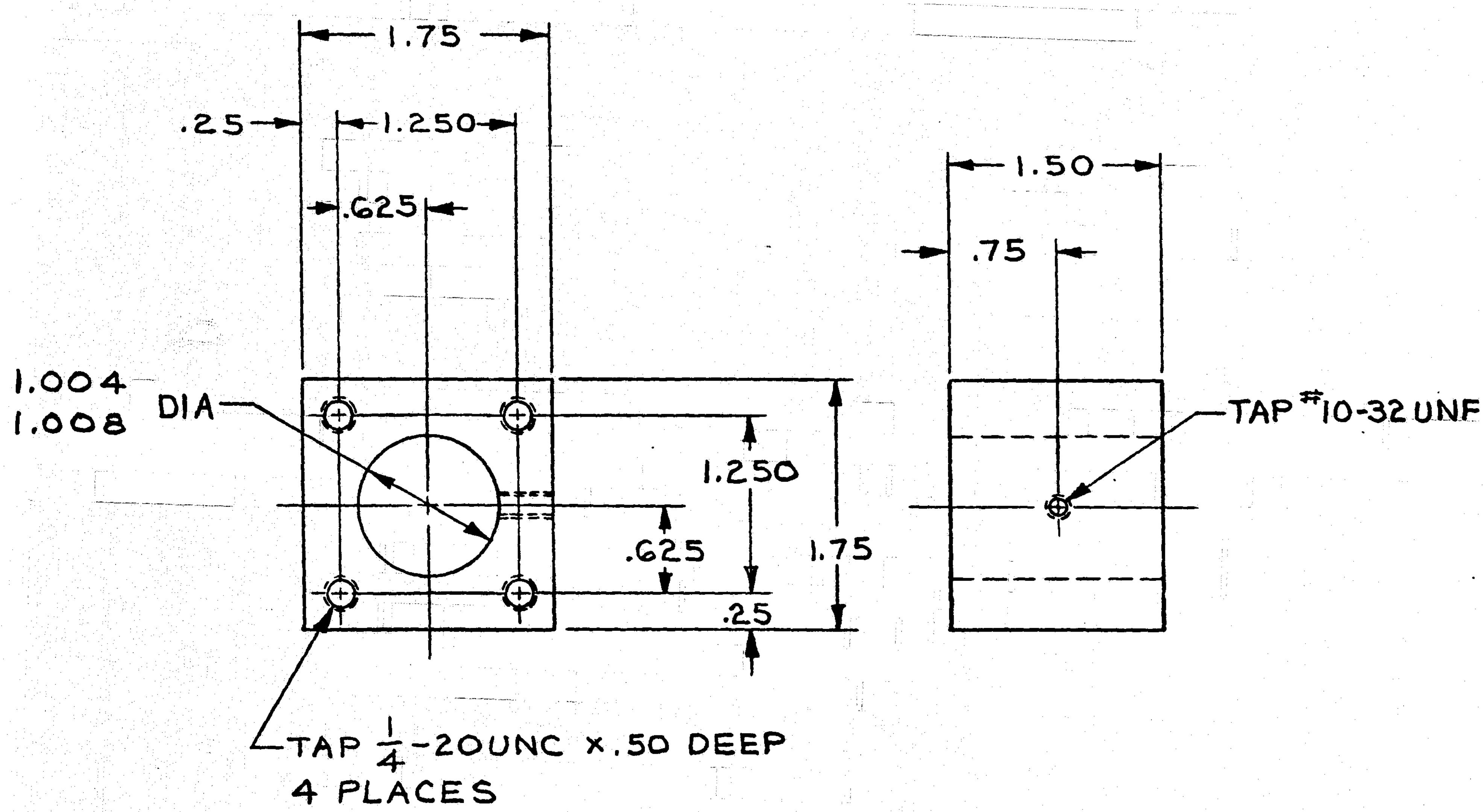
[illegible]
4/26/77
X-Y RIBBON CLAMP
SKETCH 3



MAT AL.
2 REQ
GUIDE SUPPORT
SKETCH 2
M. Lincoln 56-2
4/26/77


DRILL + TAP
6-32 THRU.
5/32
.010 R MAX
15°
1 3/4
1/2
1 1/16
1 IN
1/4
1.250
DRILL + C.SK.
#6 FLAT HEAD
SCREW - FLUSH
2 PLACES -
THIS SIDE
1/4
3/16
15°
1/8
5/8
#23 DRILL
MAT. S.S.
2 REQ
GUIDE CLAMP
SKETCH 1
M. LINCOLN 5612
4/26/77

Furnace Mount



MATERIAL: 6061-T6 ALUM.

TOLERANCE:

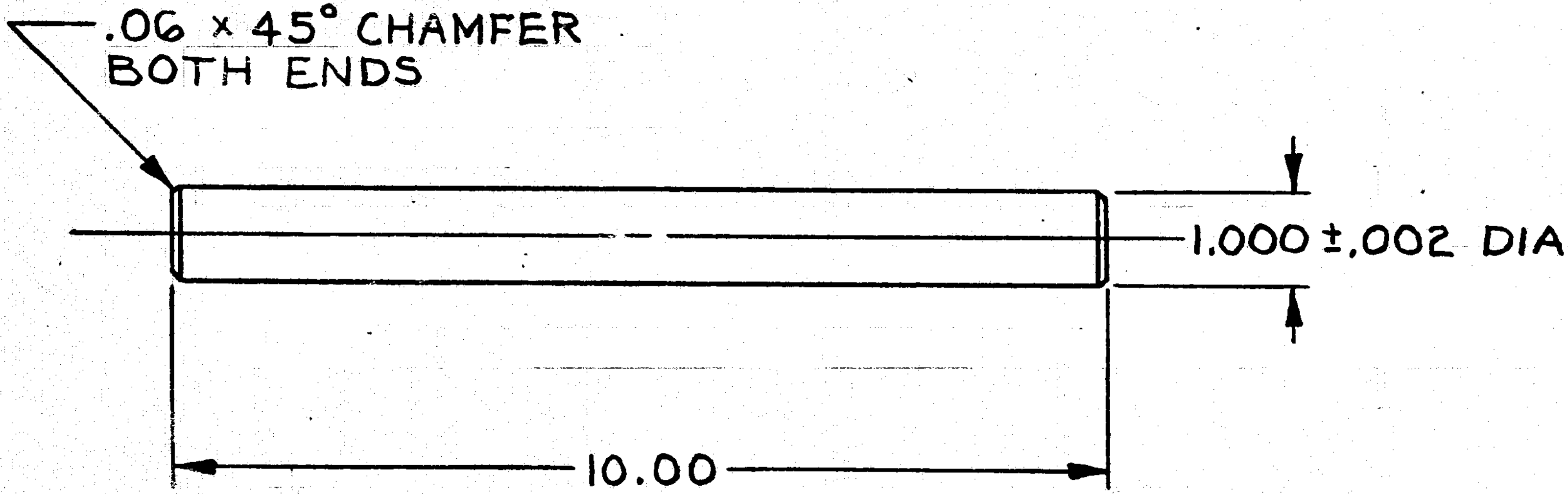
.XX ± .02

.XXX ± .005

ANCHOR BLOCK

K. TROUP 3-17-77 SCALE: 1/1

PART 3



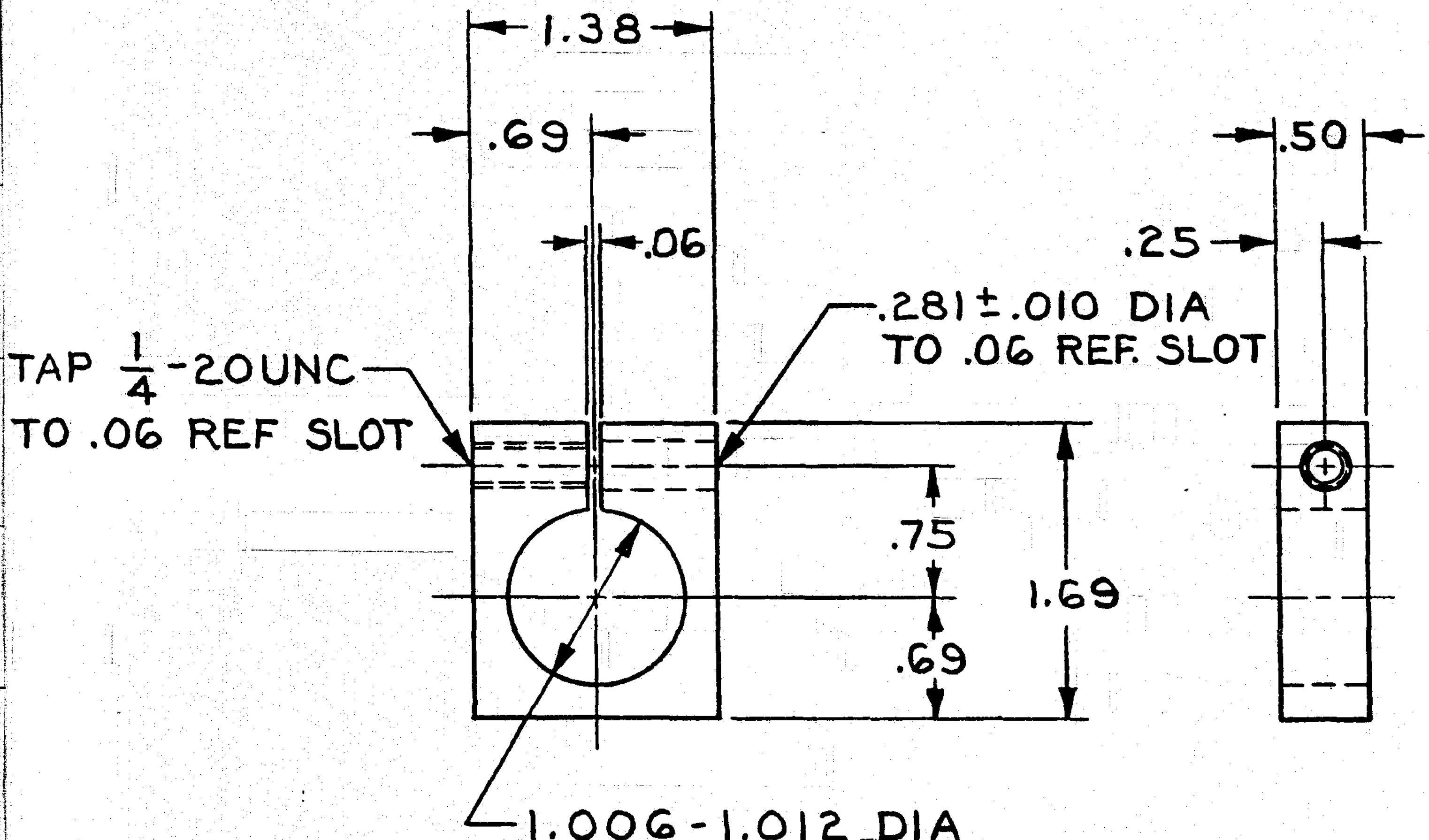
MATERIAL: 6061-T6 ALUM.

TOLERANCE:
.XX ± .02

VERT POST

K. TROUP 3-22-77 SCALE: 1/2

PART 4



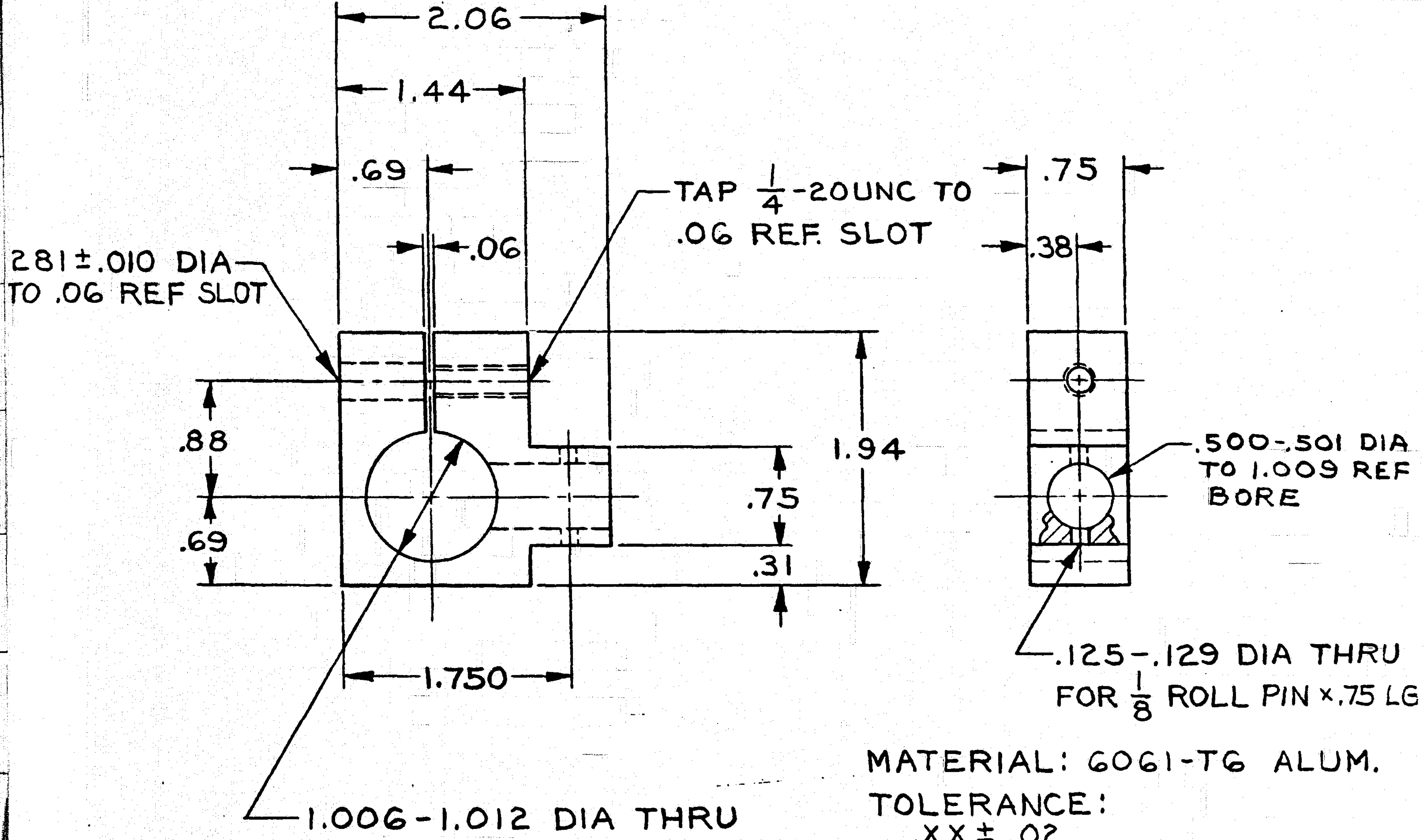
MATERIAL: 6061-T6 ALUM.

TOLERANCE:
.XX ± .02

LOCK COLLAR

K. TROUP 3-18-77 SCALE: 1/1

PART 5



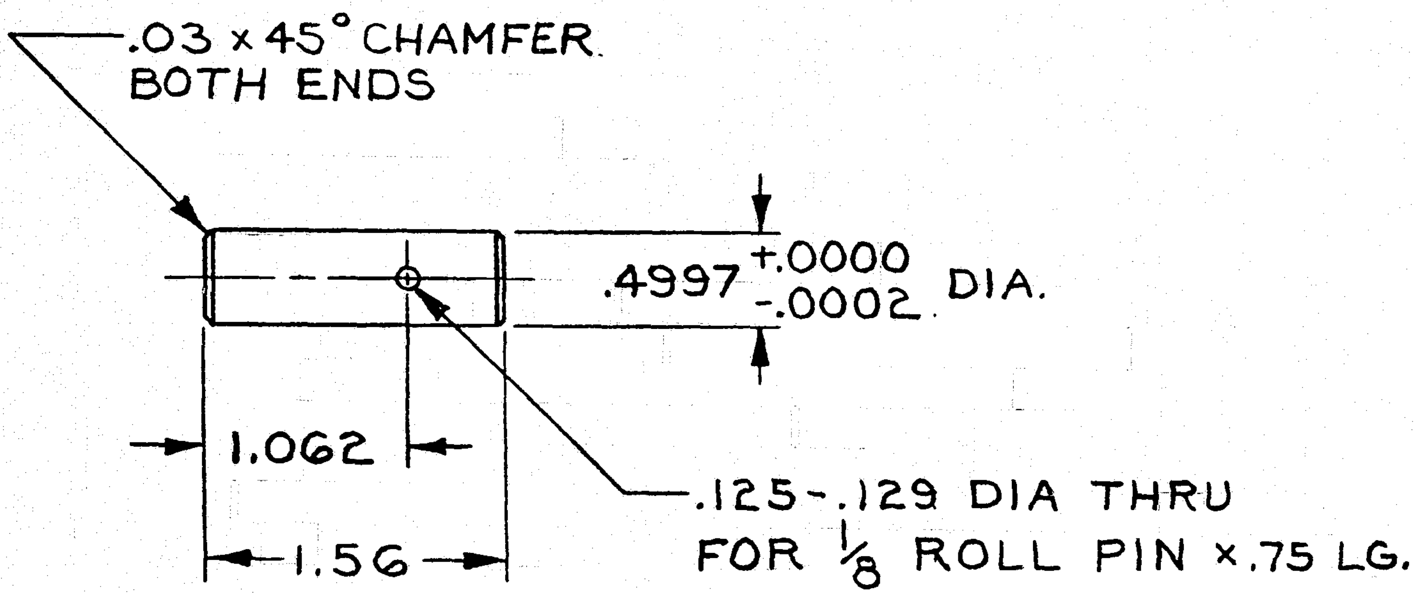
MATERIAL: 6061-T6 ALUM.

TOLERANCE:
.XX ± .02
.XXX ± .005

HORIZ. PIVOT ARM

K. TROUP 3-18-77 SCALE: 1/1

PART 6



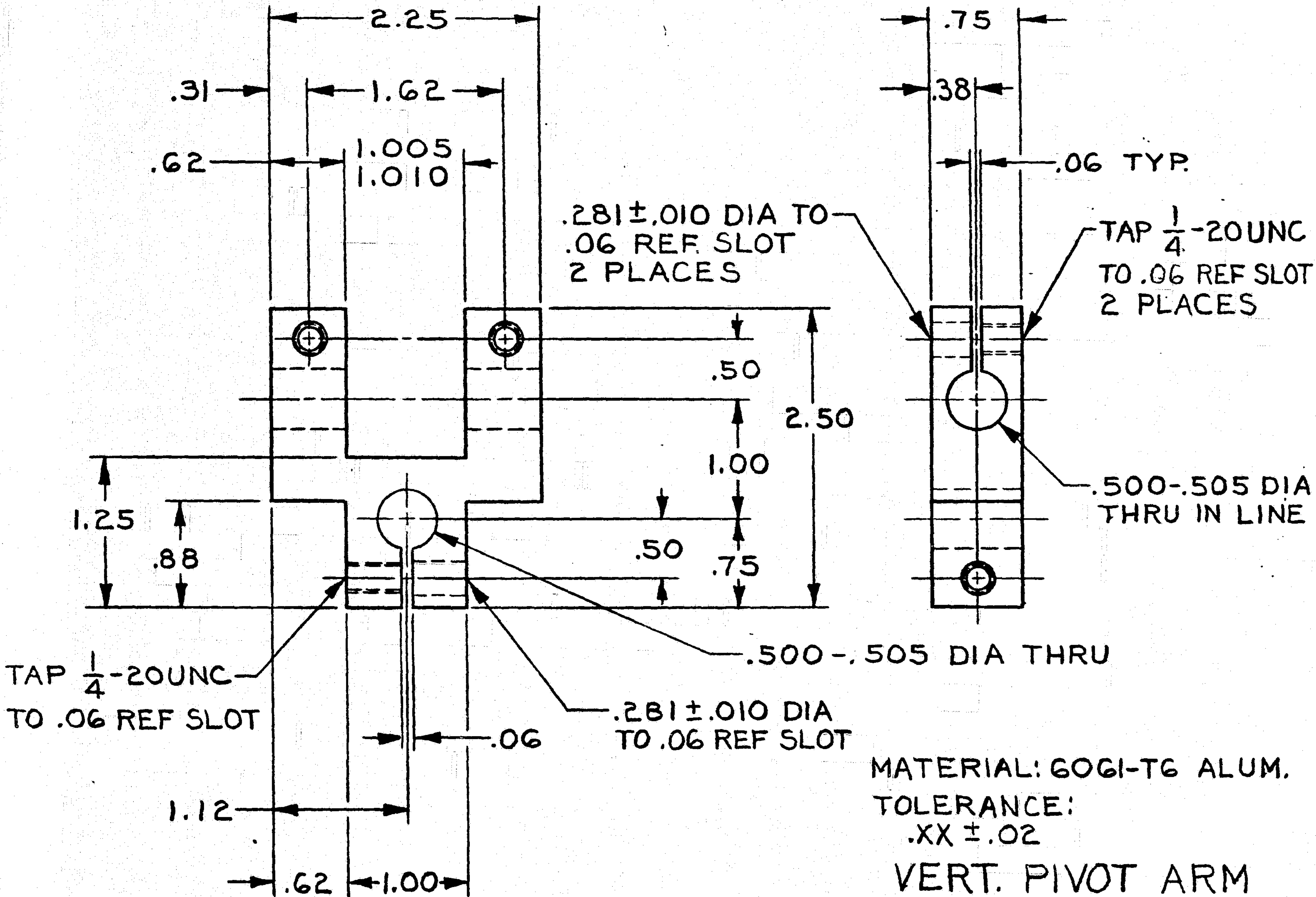
MATERIAL: TYPE 303 S.S.

TOLERANCE:
.XX ± .02

VERT. PIVOT SHAFT

K. TROUP 3-22-77 SCALE: 1/1

PART 7



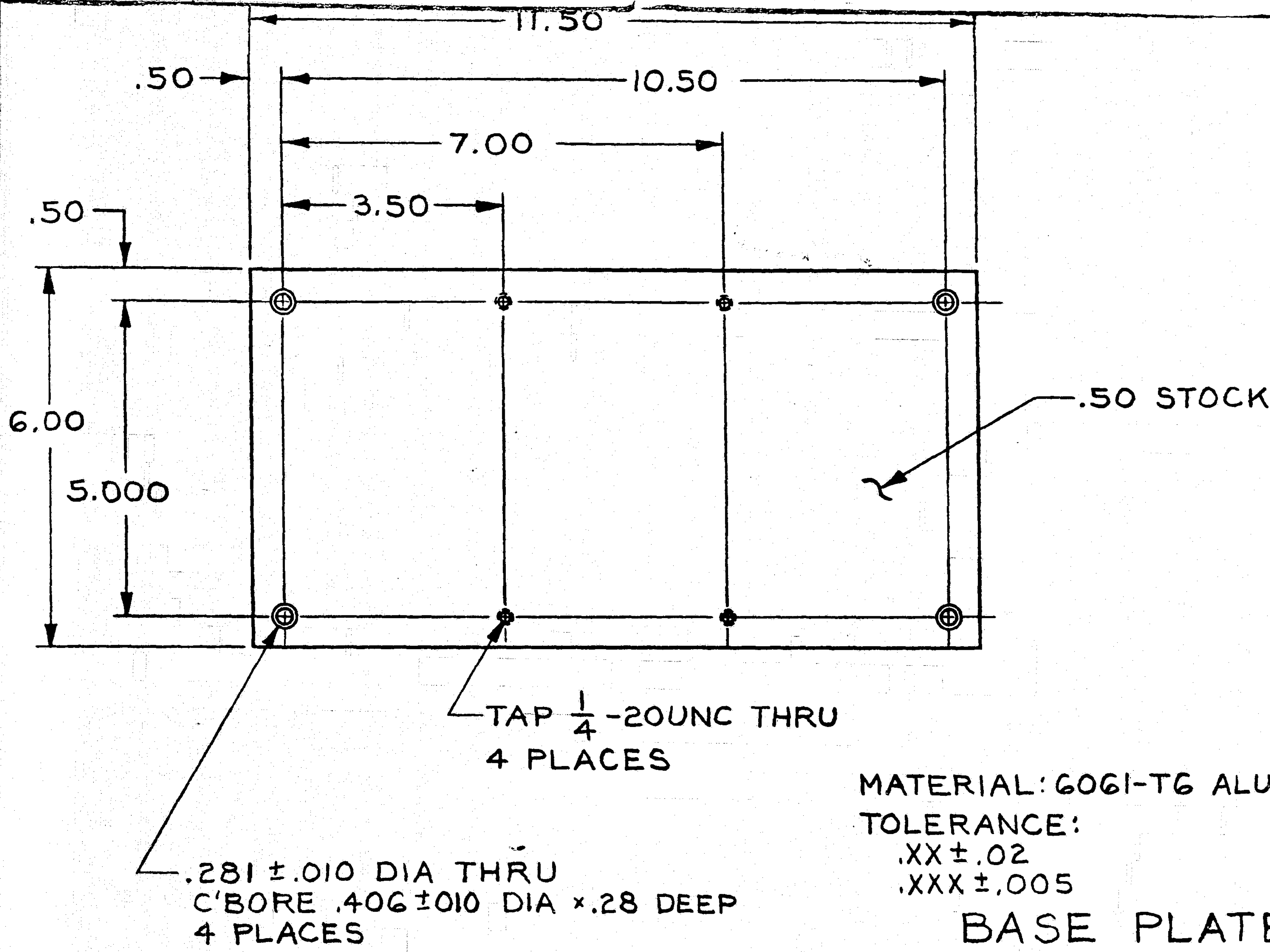
MATERIAL: 6061-T6 ALUM.

TOLERANCE:
.XX ± .02

VERT. PIVOT ARM

K. TROUP 3-21-77 SCALE: 1/1

PART 8



MATERIAL: 6061-T6 ALUM.

TOLERANCE:

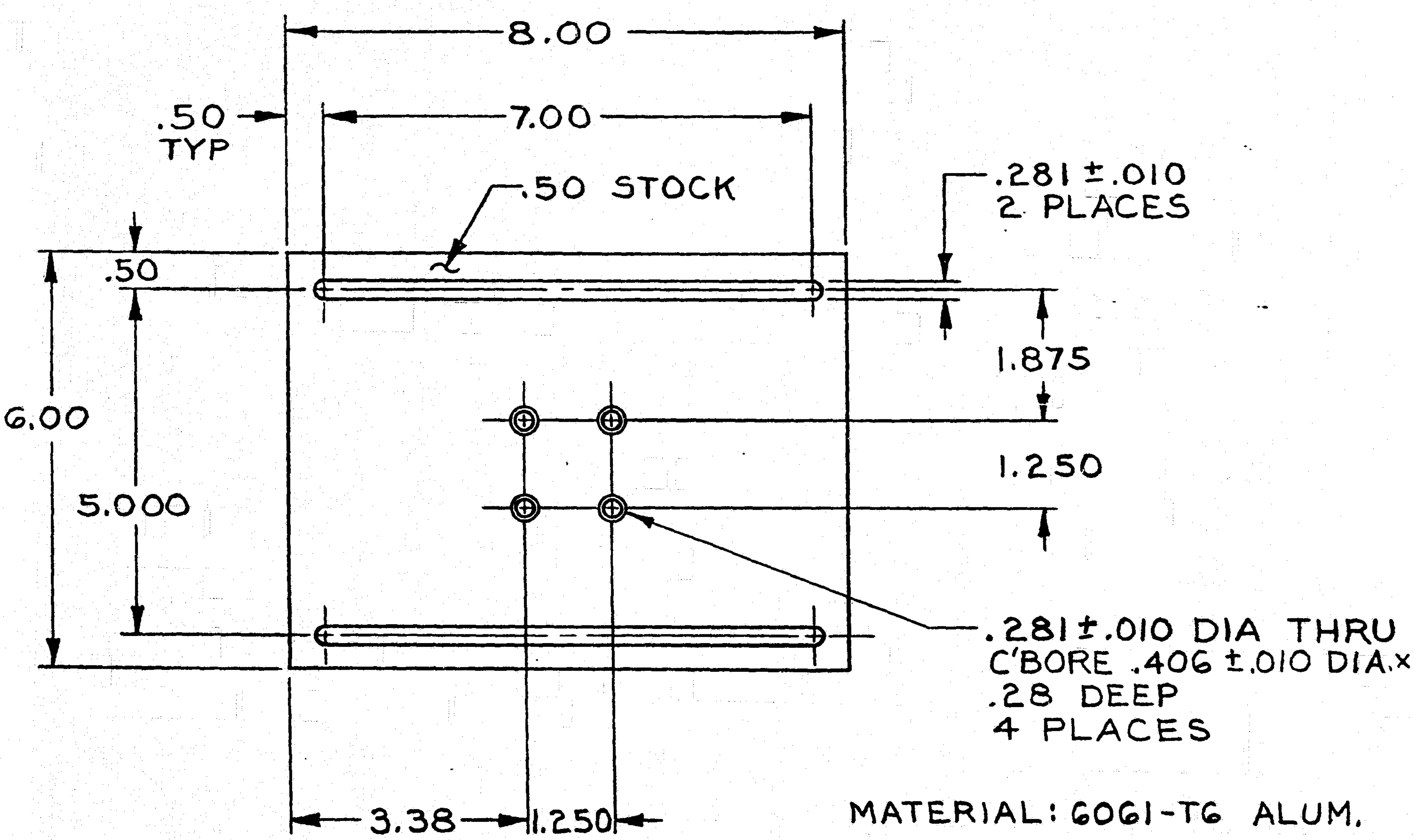
.XX ±.02

.XXX ±.005

BASE PLATE

K.TROUP 3-18-77 SCALE: 1/2

PART 1



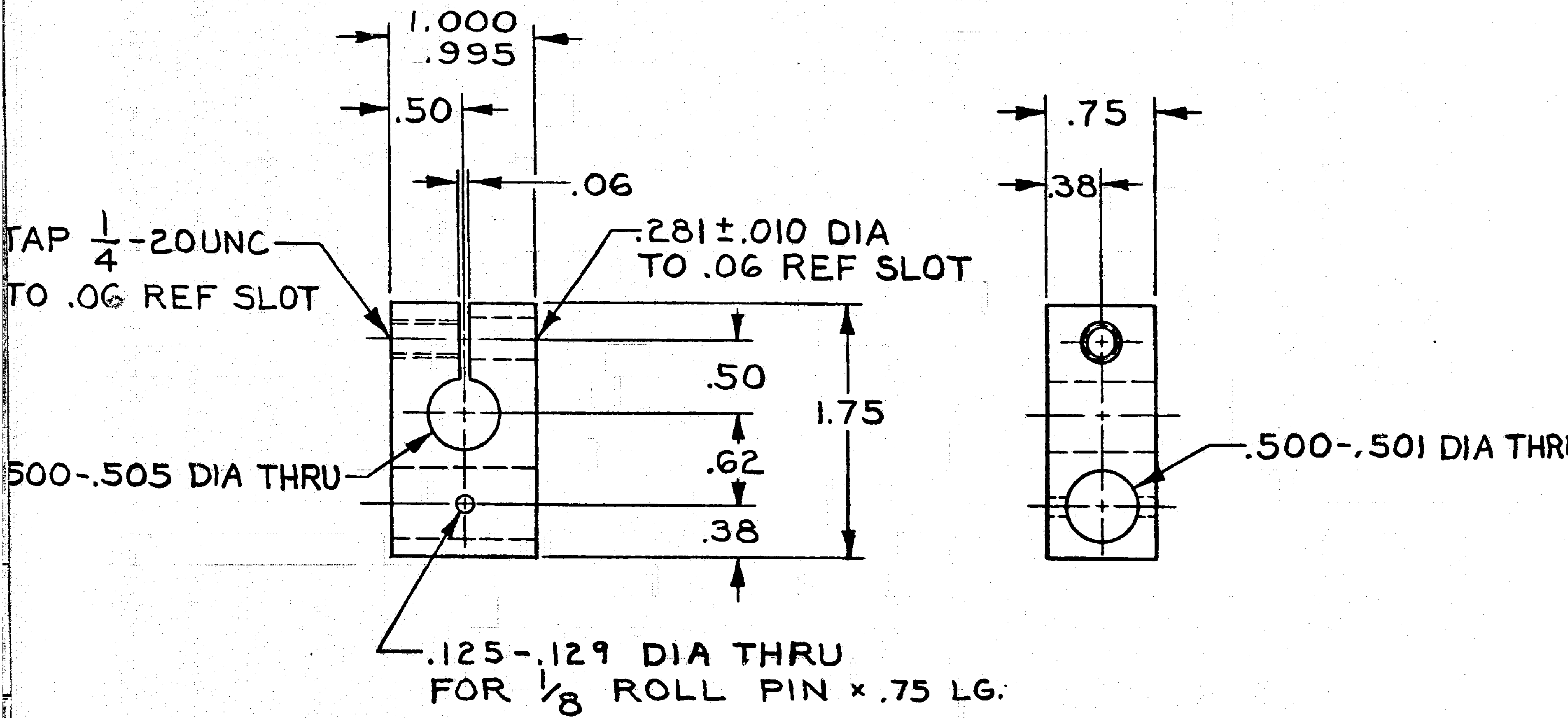
MATERIAL: 6061-T6 ALUM.

TOLERANCE:
.XX ± .02
.XXX ± .005

ANCHOR PLATE

K. TROUP 3-18-77 SCALE: 1/2

PART 2



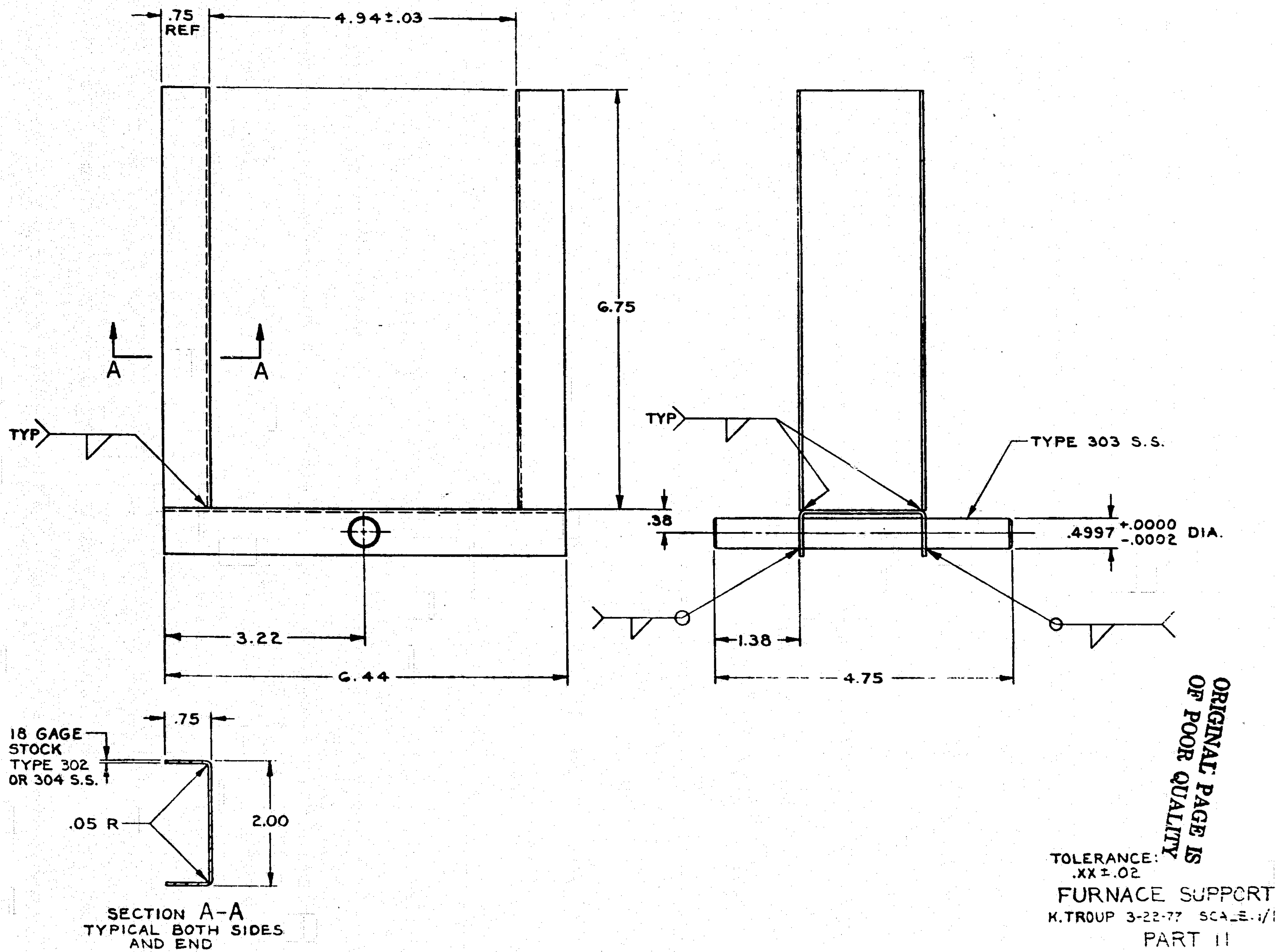
MATERIAL: 6061-T6 ALUM.

TOLERANCE:
.XX ± .02

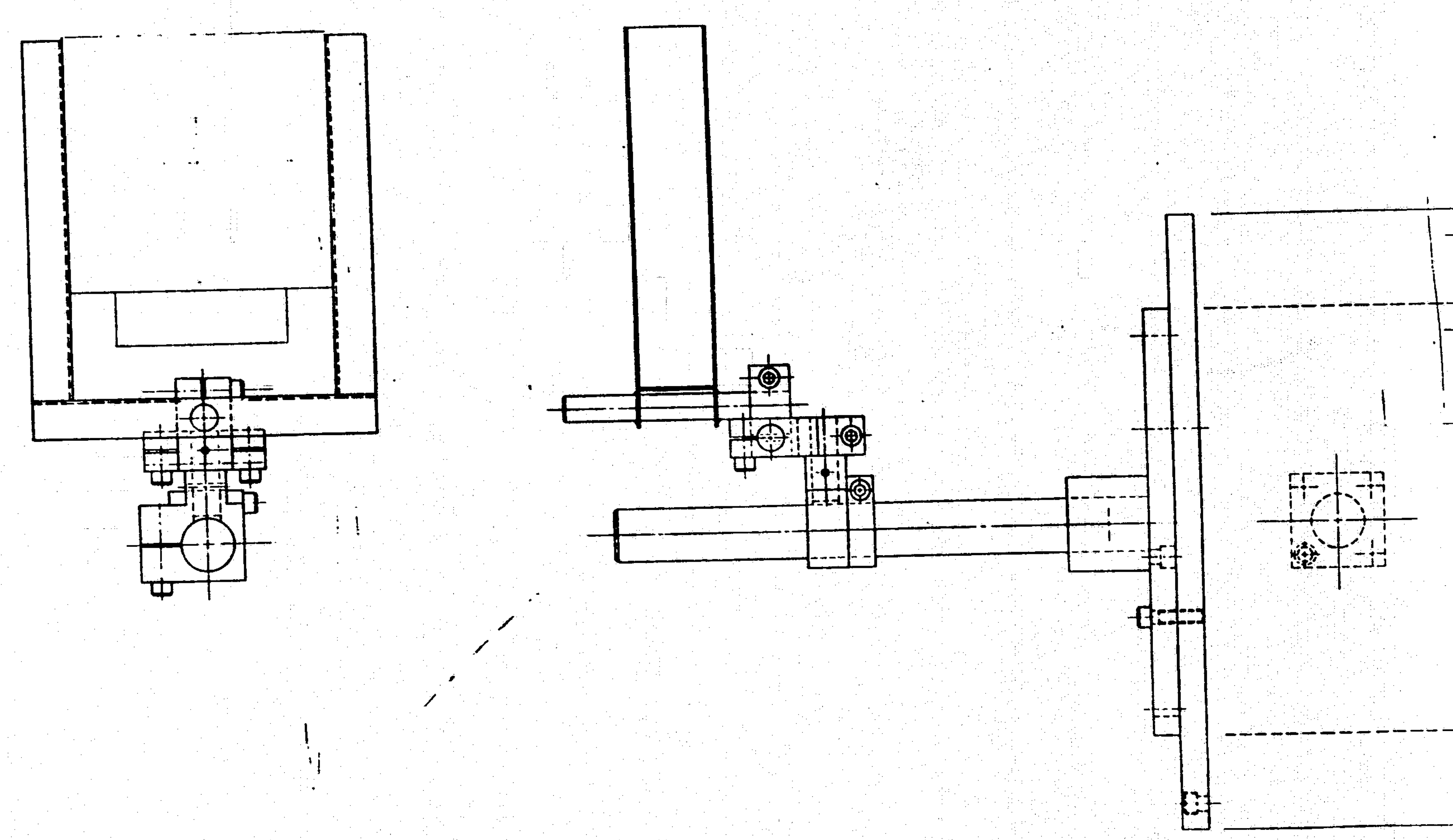
SUPPORT PIVOT

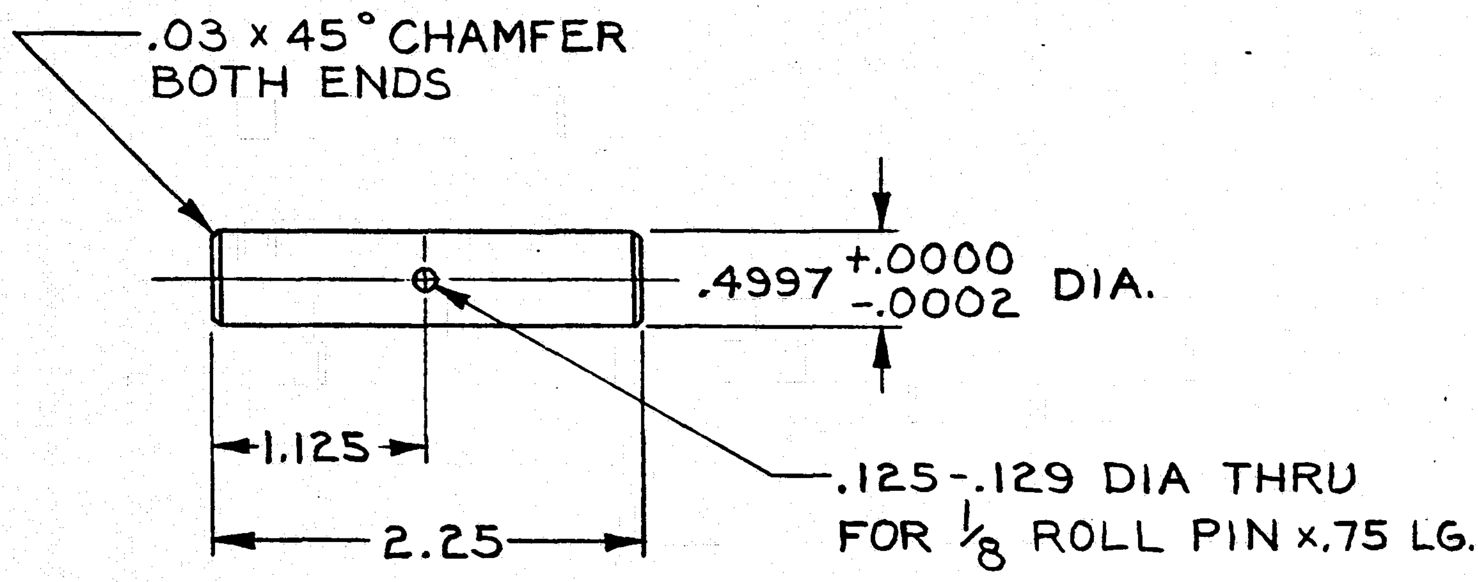
K.TROUP 3-21-77 SCALE: 1/1

PART 10



.75 REF
4.94±.03
6.75
A
A
TYP
TYP
TYPE 303 S.S.
.38
.4997 +.0000 -.0002 DIA.
3.22
6.44
1.38
4.75
.75
18 GAGE STOCK TYPE 302 OR 304 S.S.
.05 R
2.00
SECTION A-A
TYPICAL BOTH SIDES AND END
TOLERANCE:
.XX ±.02
FURNACE SUPPORT
K.TROUP 3-22-77 SCALE 1/1
PART 11





MATERIAL: TYPE 303 S.S.

TOLERANCE:
.XX ± .02 .XXX ± .005

SUPPORT PIVOT SHAFT

K.TROUP 3-22-77 SCALE: 1/1

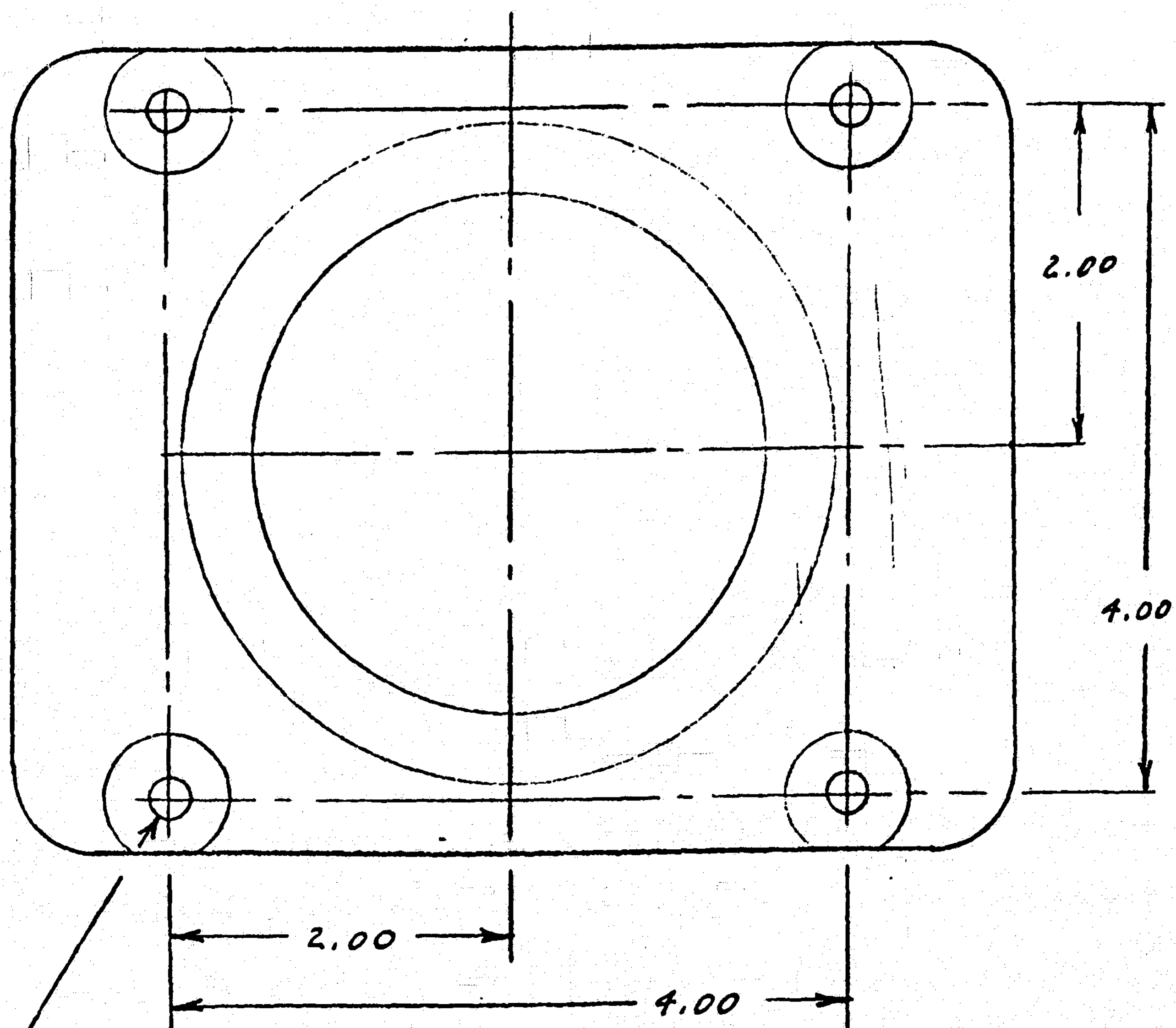
PART 9

New RTR Apparatus

ORIGINAL PAGE IS
OF POOR QUALITY

TB010630430 (8/74)

PREPARED BY: F. L. MARKOWSKI	MOTOROLA INC. Semiconductor Group	PAGE NO. OF
CHECKED BY:		WORK ORDER NO.
DATE: 3-31-77	3" COLUMN FLANGE	DWG. NO. R-0261-77

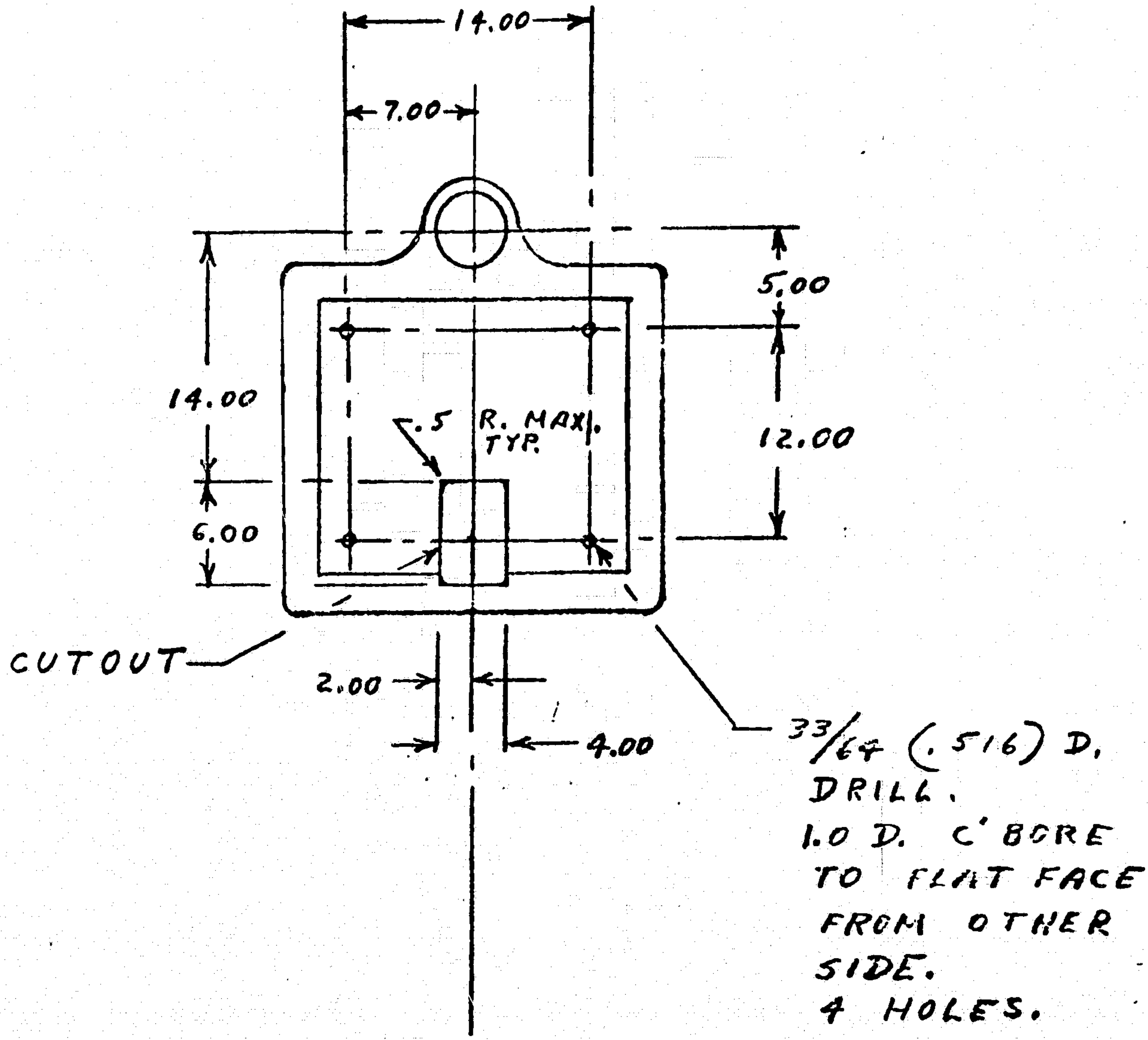


9/32 (.281) D. DRILL.
3/4 D. C'BORE TO
FLAT FACE.
4 HOLES

REWORK POWERMATIC
3" FLANGE

TB010633430 (8/74)

PREPARED BY: MARKOWSKI	MOTOROLA INC. Semiconductor Group	PAGE NO. OF
CHECKED BY:		WORK ORDER NO.
DATE 3-31-77	TOP PLATE MOUNT BRACKET	DWG. NO. R-0260-77

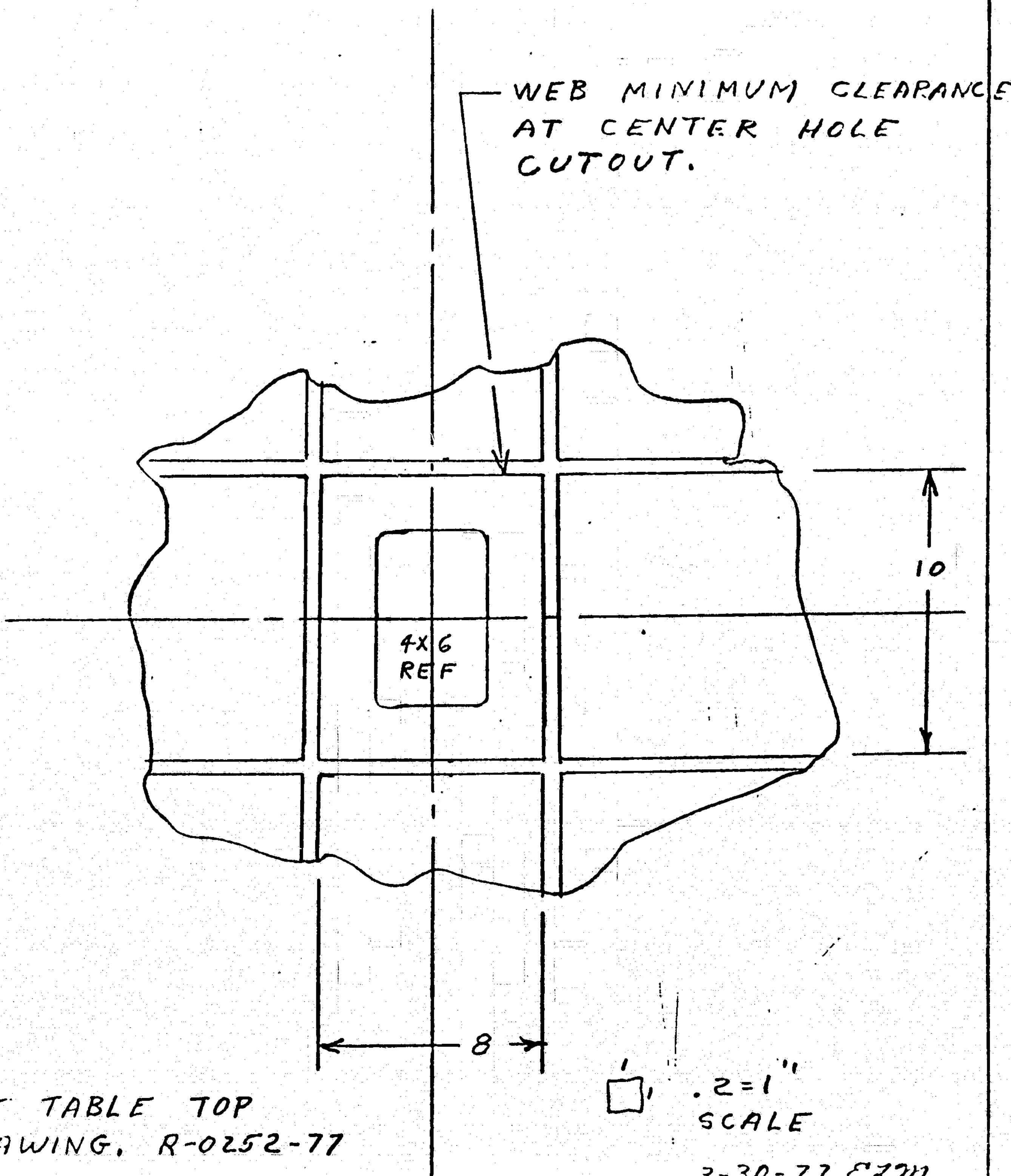


REWORK POWERMATIC PRODUCTION TABLE

ORIGINAL PAGE IS
OF POOR QUALITY

TB010630430 (8/74)

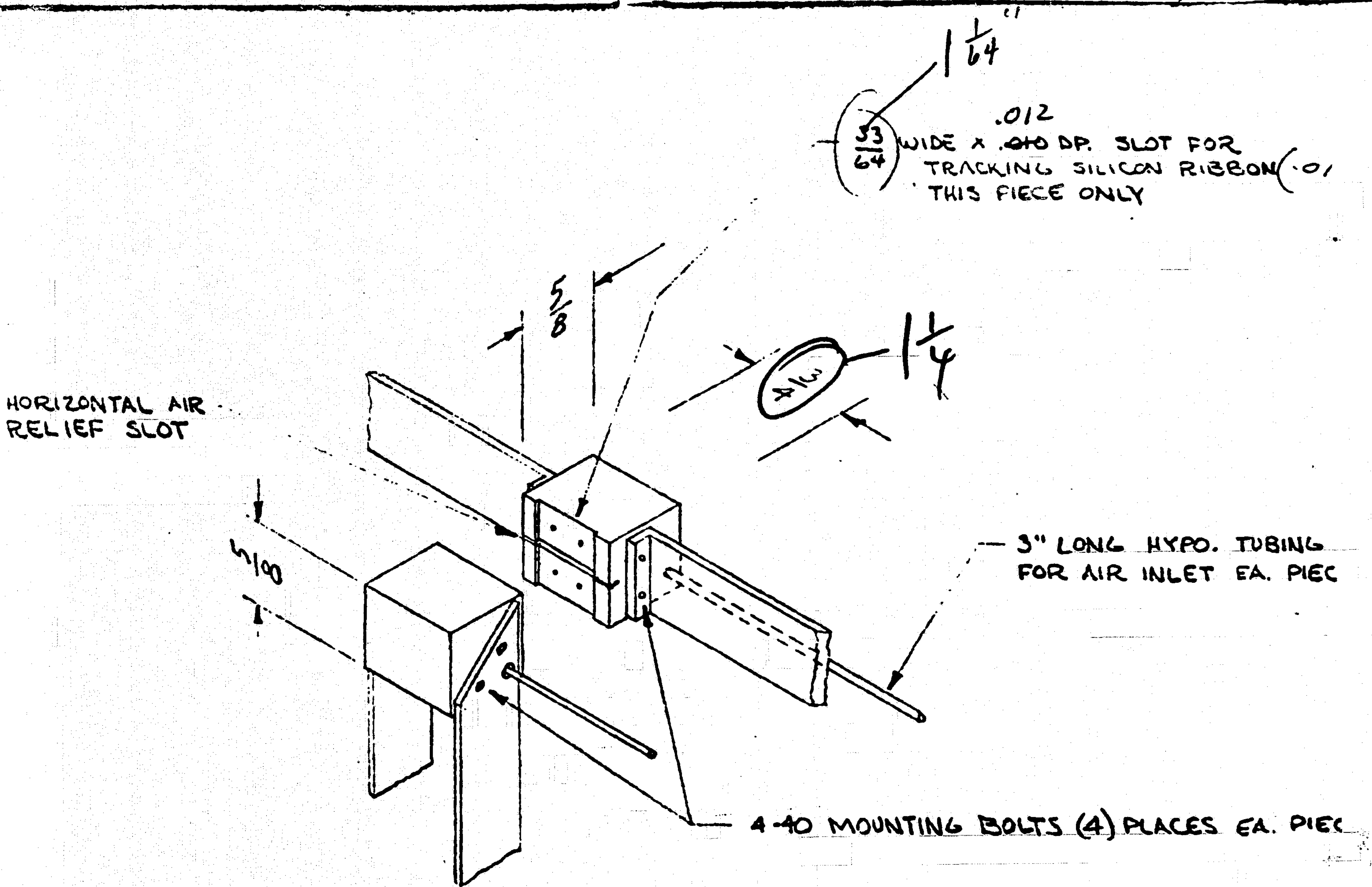
PREPARED BY: C.L.M.	MOTOROLA INC. Semiconductor Group	PAGE NO. OF
CHECKED BY:		WORK ORDER NO.
DATE: 3-30-77	TABLE TOP WEB.	DWG. NO. R-0254-77



SEE TABLE TOP DRAWING. R-0252-77

.2=1"
SCALE

3-30-77 ELM

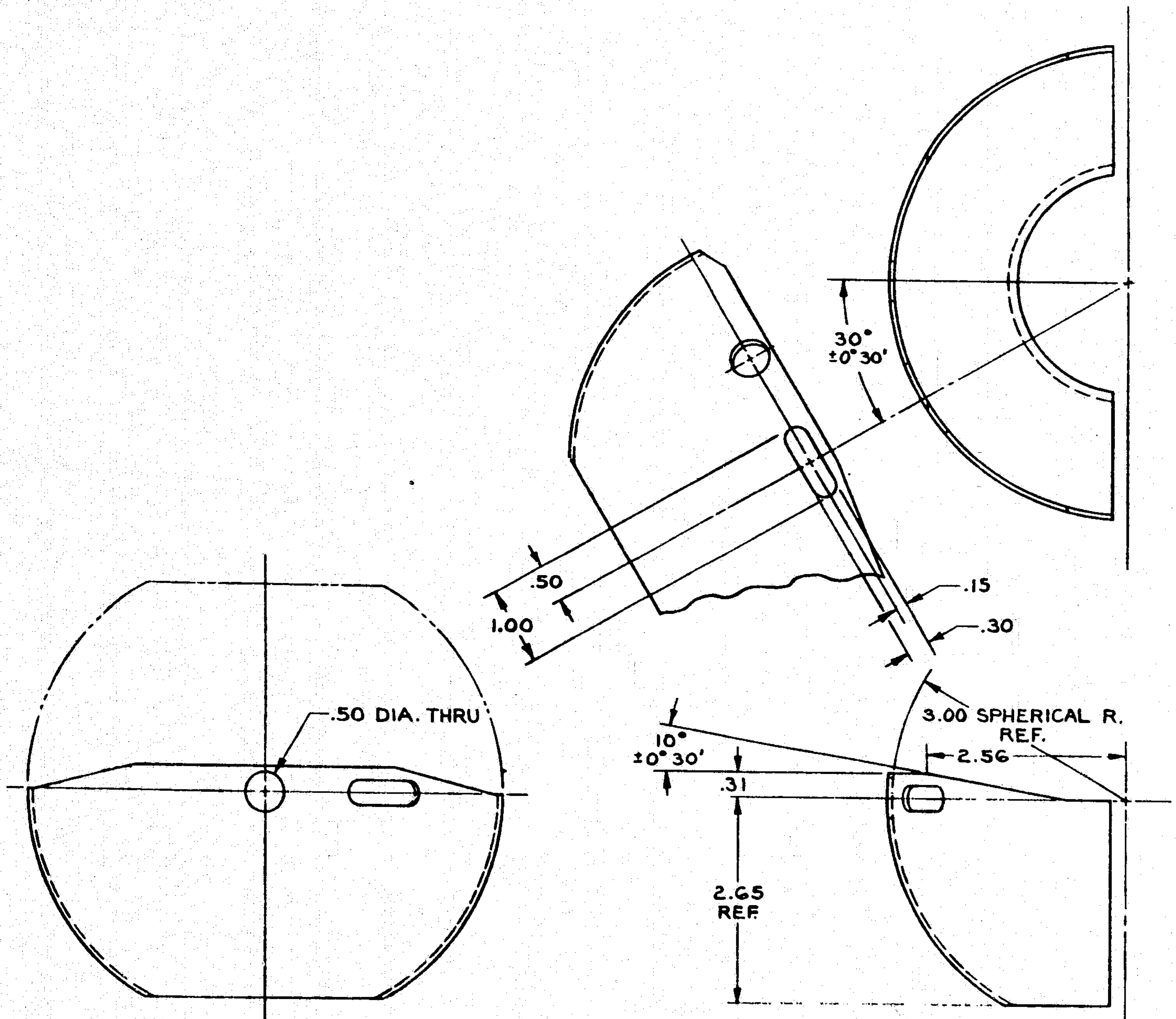


DOVER INSTRUMENTS

MOTOROLA RIBBON GUIDE

SCALE: FULL 4/11/77 [illegible]

SKETCH #44

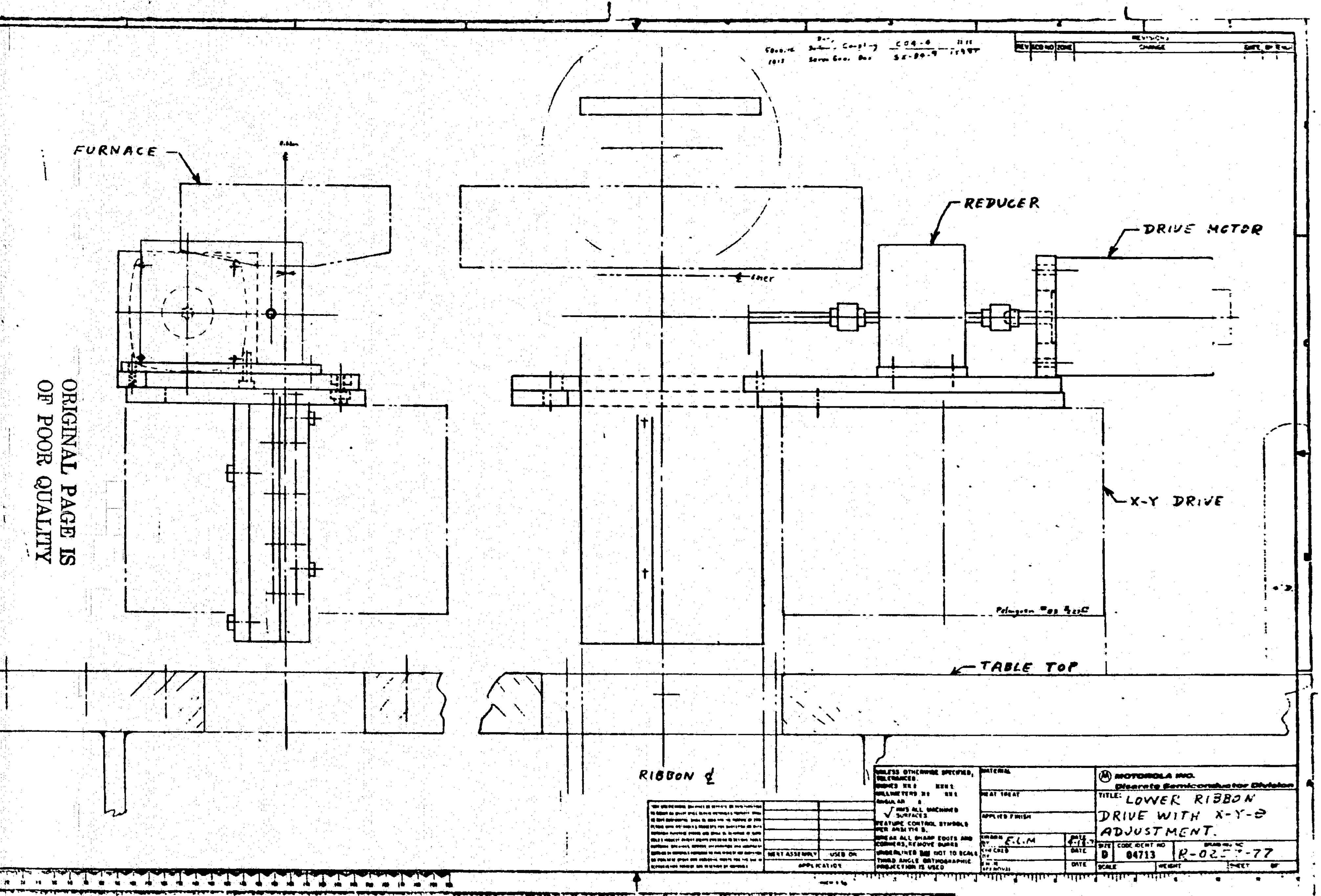


TOLERANCE:
.XX ± .01

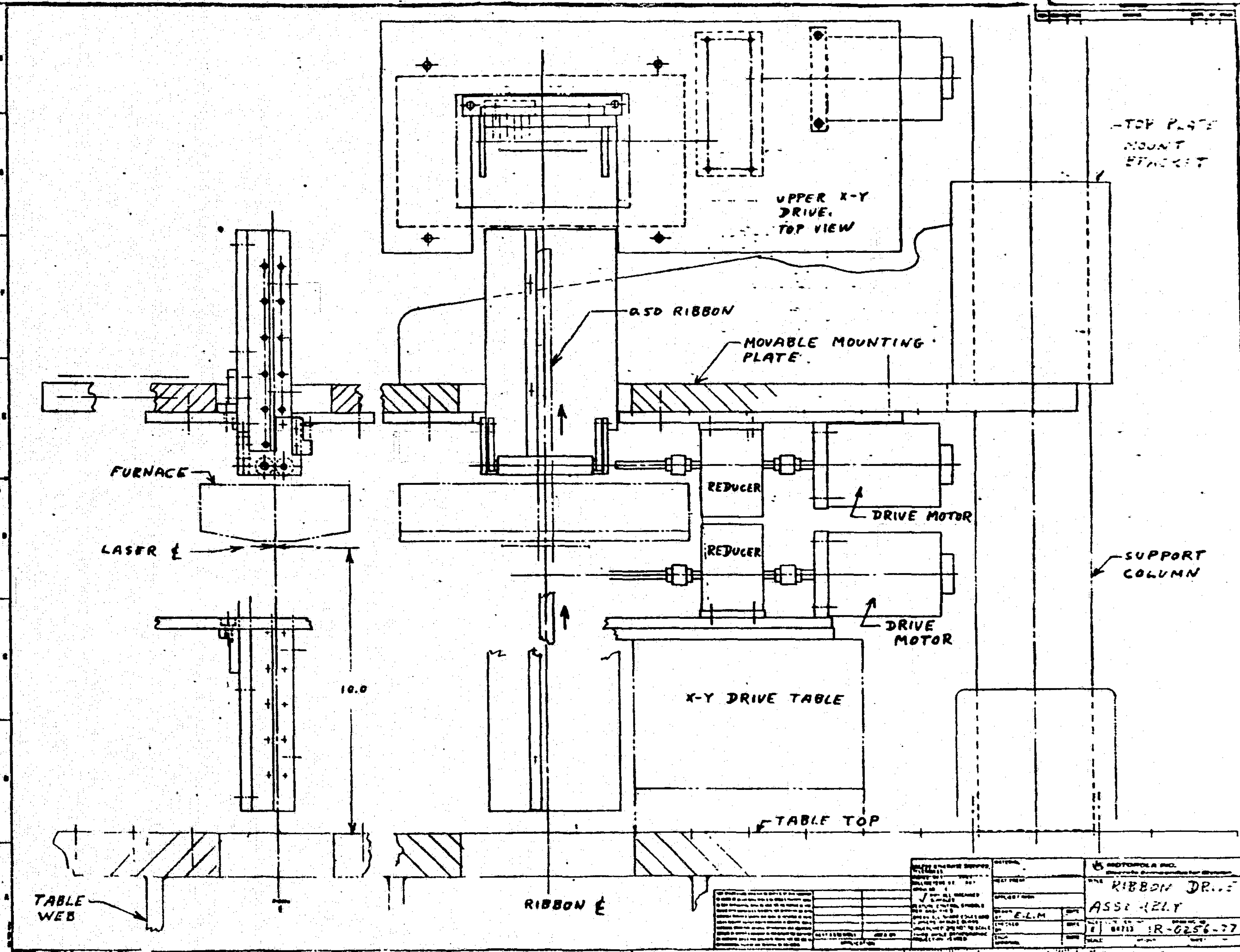
HEMISPHERE REWORK

K. TROUP 4-13-77 SCALE: 1/1

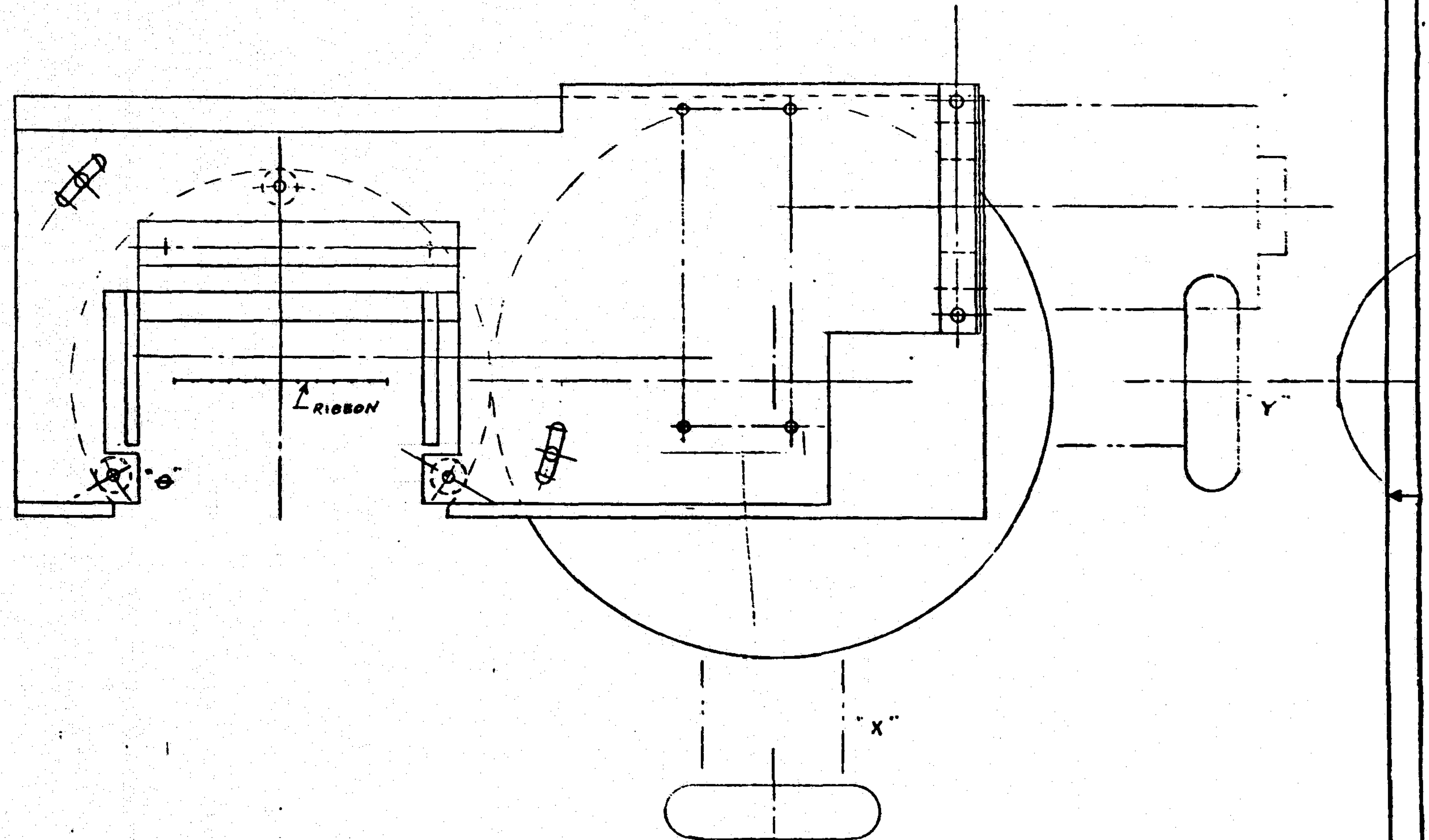
SK 041577 2


FURNACE
REDUCER
DRIVE MOTOR
X-Y DRIVE
TABLE TOP
RIBBON ℄
MOTOROLA INC.
Discrete Semiconductor Division
TITLE: LOWER RIBBON DRIVE WITH X-Y-θ ADJUSTMENT.
84713
E.L.M

ORIGINAL PAGE IS OF POOR QUALITY



REVISIONS					
REV	ECO NO	CHANGE	DATE	BY	ENGR



NEXT ASSEMBLY	USED ON
APPLICATION	

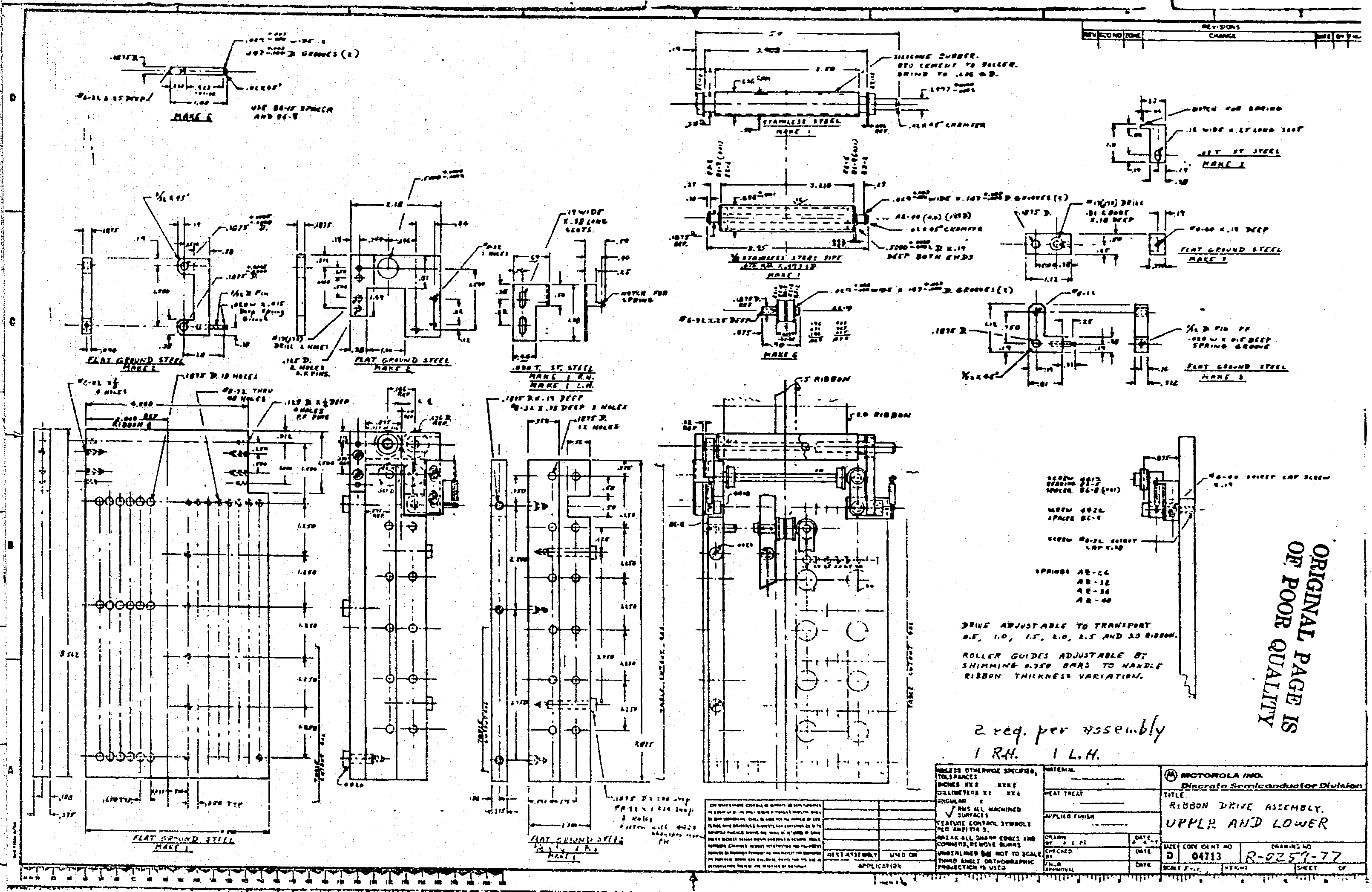
UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± .XXX ±
MILLIMETERS .X ± .XX ±
ANGULAR ±
√ RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED

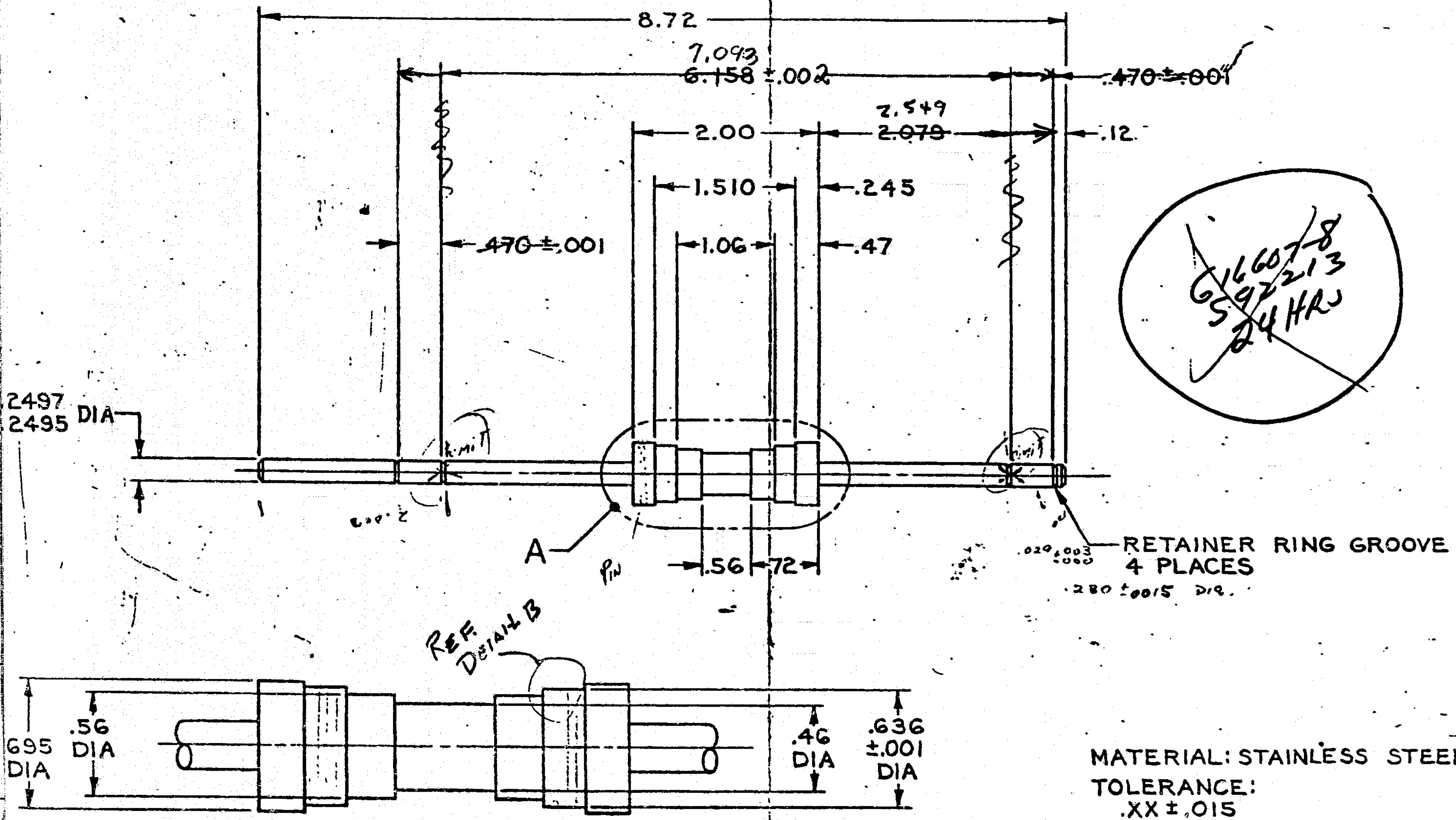
MATERIAL	
HEAT TREAT	
APPLIED FINISH	
DRAWN BY F.L.M	DATE 4-15-7
CHECKED BY	DATE
ENGR APPROVAL	DATE

MOTOROLA INC.
Discrete Semiconductor Division

TITLE: X-Y-θ ADJUSTMENT

SIZE	CODE IDENT NO	DRAWING NO.
C	04713	R-8258-77
SCALE	WEIGHT	SHEET OF


FLAT GROUND STEEL MAKE 2
FLAT GROUND STEEL MAKE 1
MAKE 6
MAKE 1
FLAT GROUND STEEL MAKE 3
DRIVE ADJUSTABLE TO TRANSPORT 0.5, 1.0, 1.5, 2.0, 2.5 AND 3.0 RIBBON.
ROLLER GUIDES ADJUSTABLE BY SHIMMING 0.350 BARS TO HANDLE RIBBON THICKNESS VARIATION.
2 req. per assembly
1 R.H. 1 L.H.
MOTOROLA INC.
Discrete Semiconductor Division
TITLE
RIBBON DRIVE ASSEMBLY,
UPPER AND LOWER
D
04713
R-0259-77
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED



VIEW A
SCALE: 2/1

2 pcs and finishes permissable

MATERIAL: STAINLESS STEEL

TOLERANCE:
.XX ± .015
.XXX ± .005

2 REQ'D

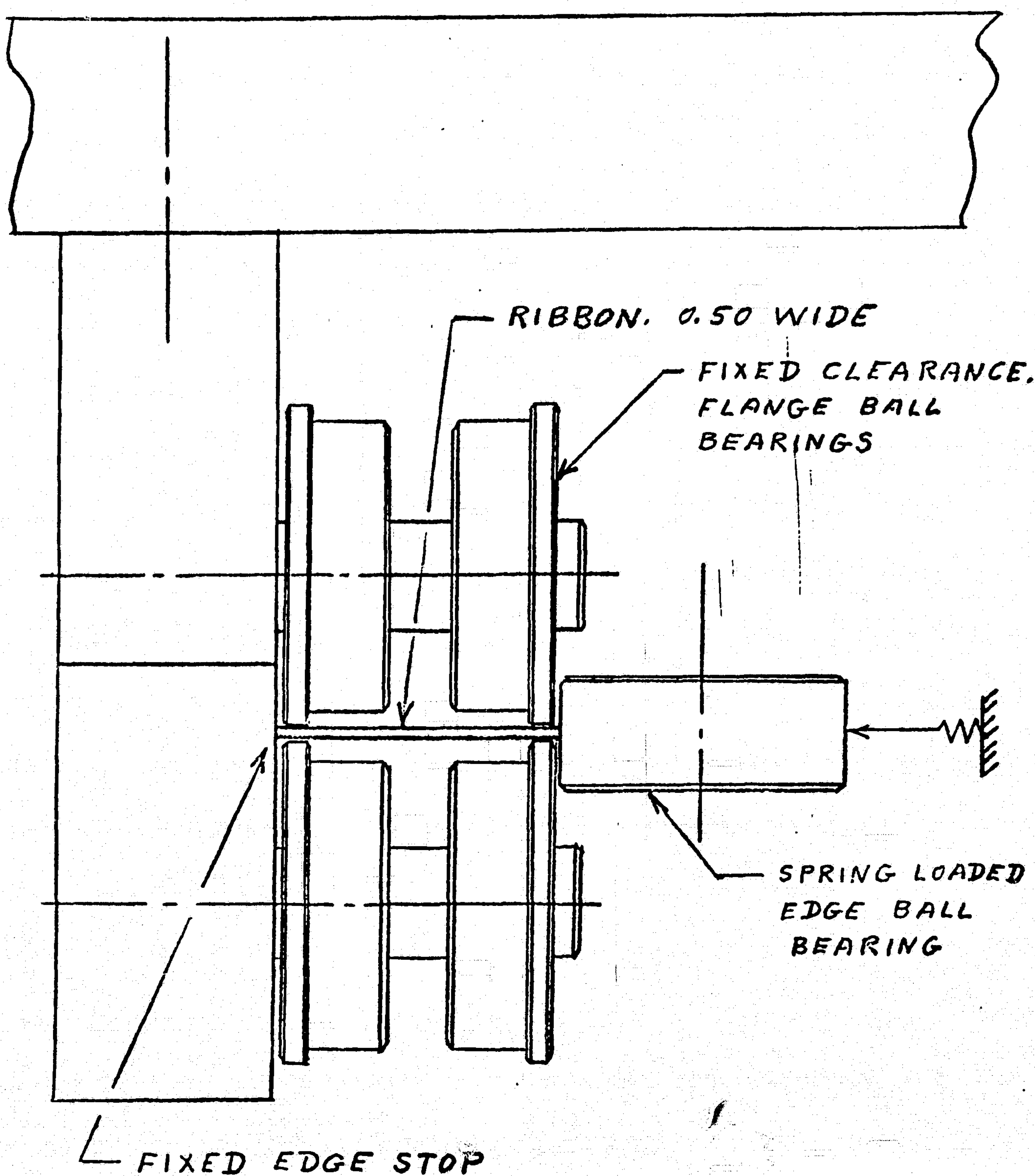
DRIVE ROLLER

K. TROUP 3-30-77 SCALE: 1/1

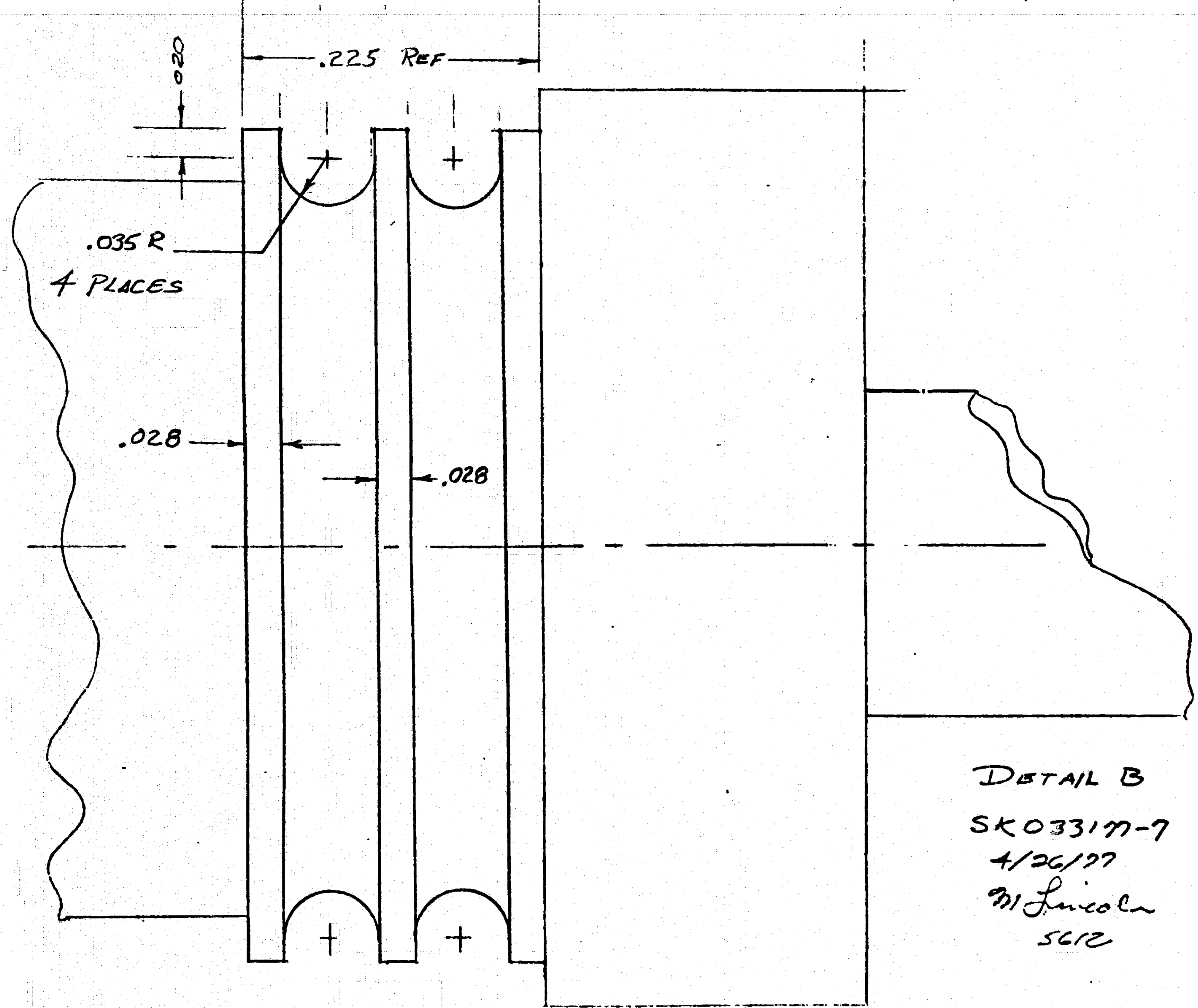
SK033177-7

TB010630430 (8/74)

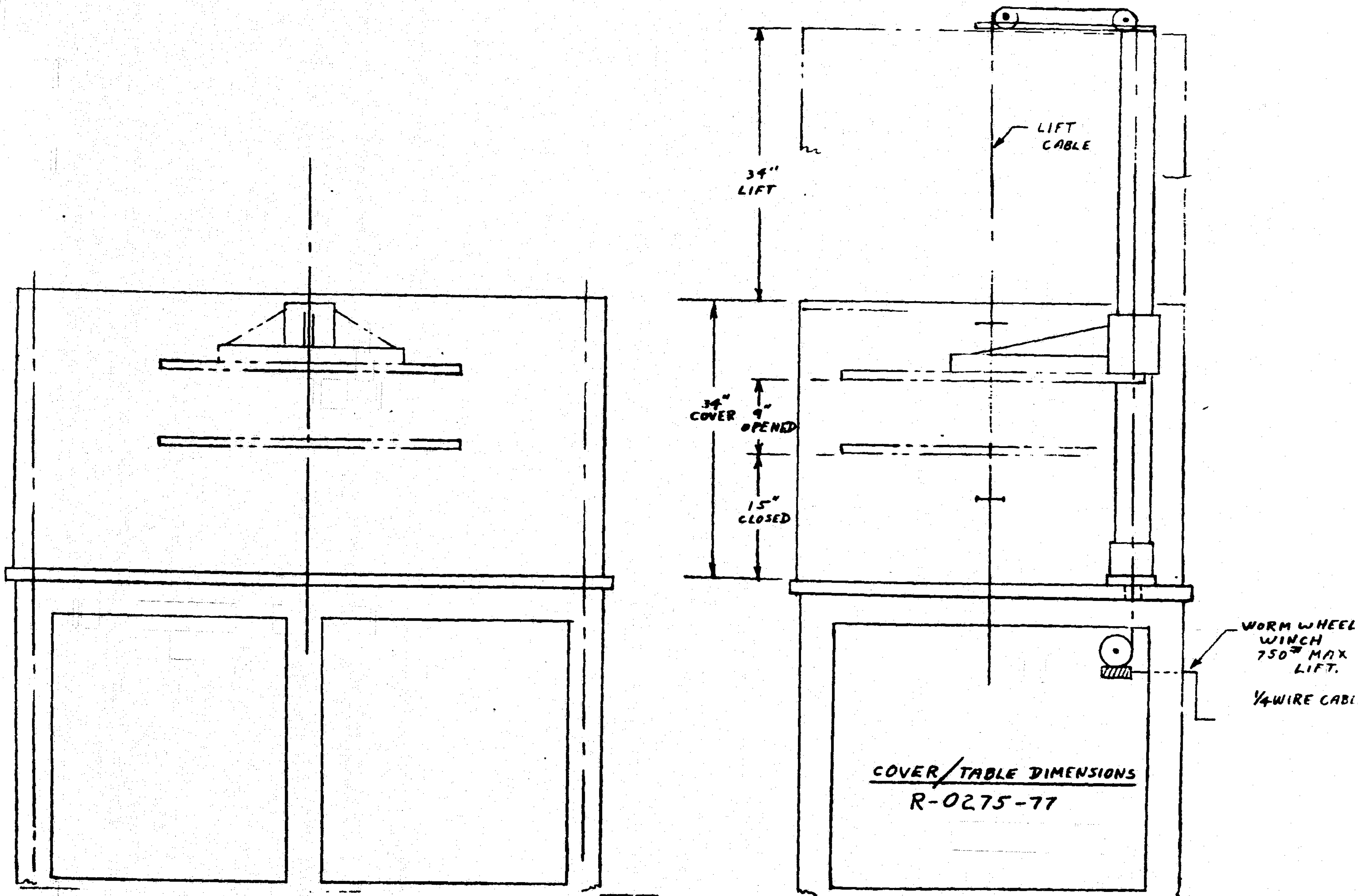
PREPARED BY: MARKOWSKI	MOTOROLA INC. Semiconductor Group	PAGE NO. OF
CHECKED BY:		WORK ORDER NO.
DATE: 5-3-77	RIBBON GUIDE	DWG. NO. R-0262-77

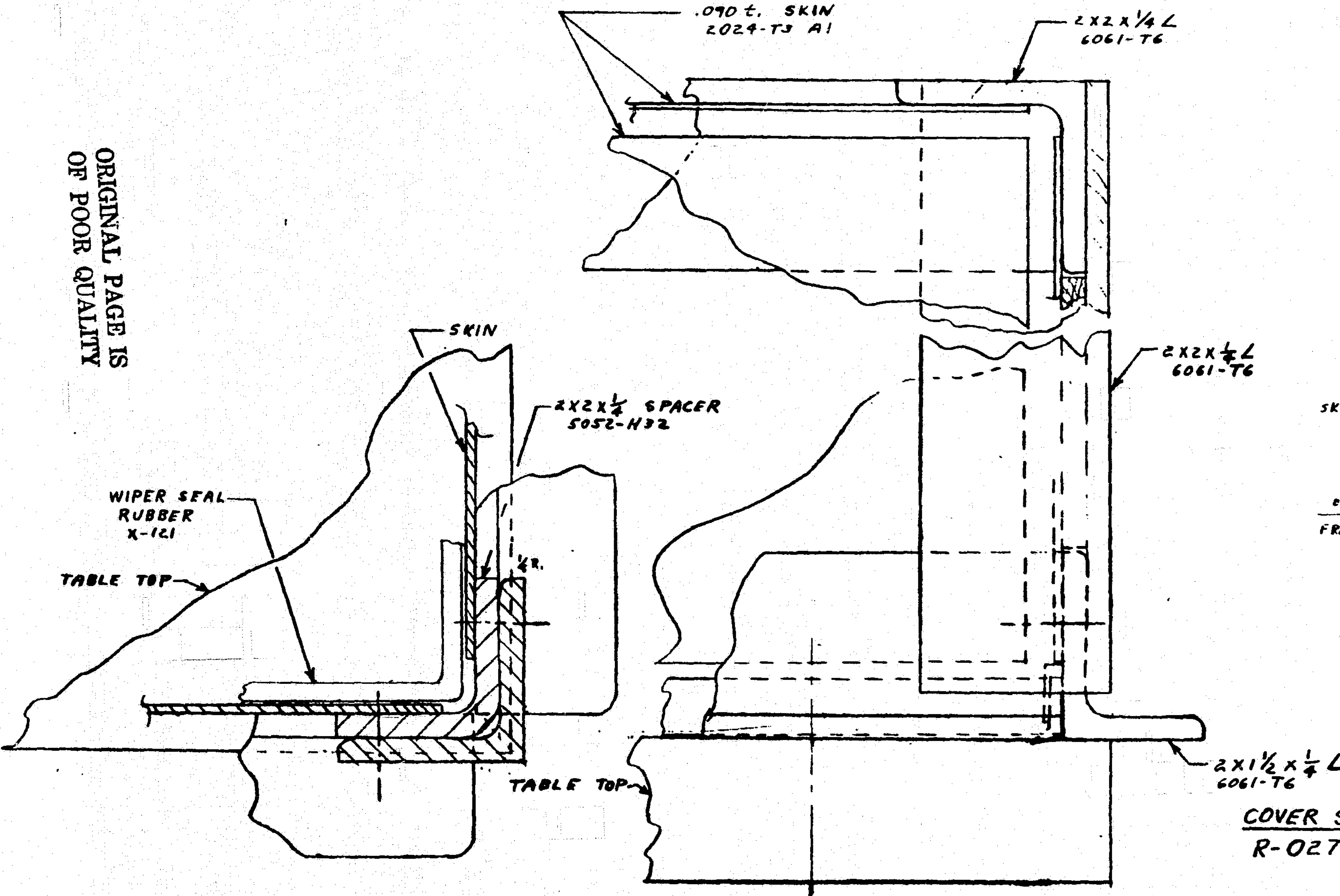


SCALE 4=1

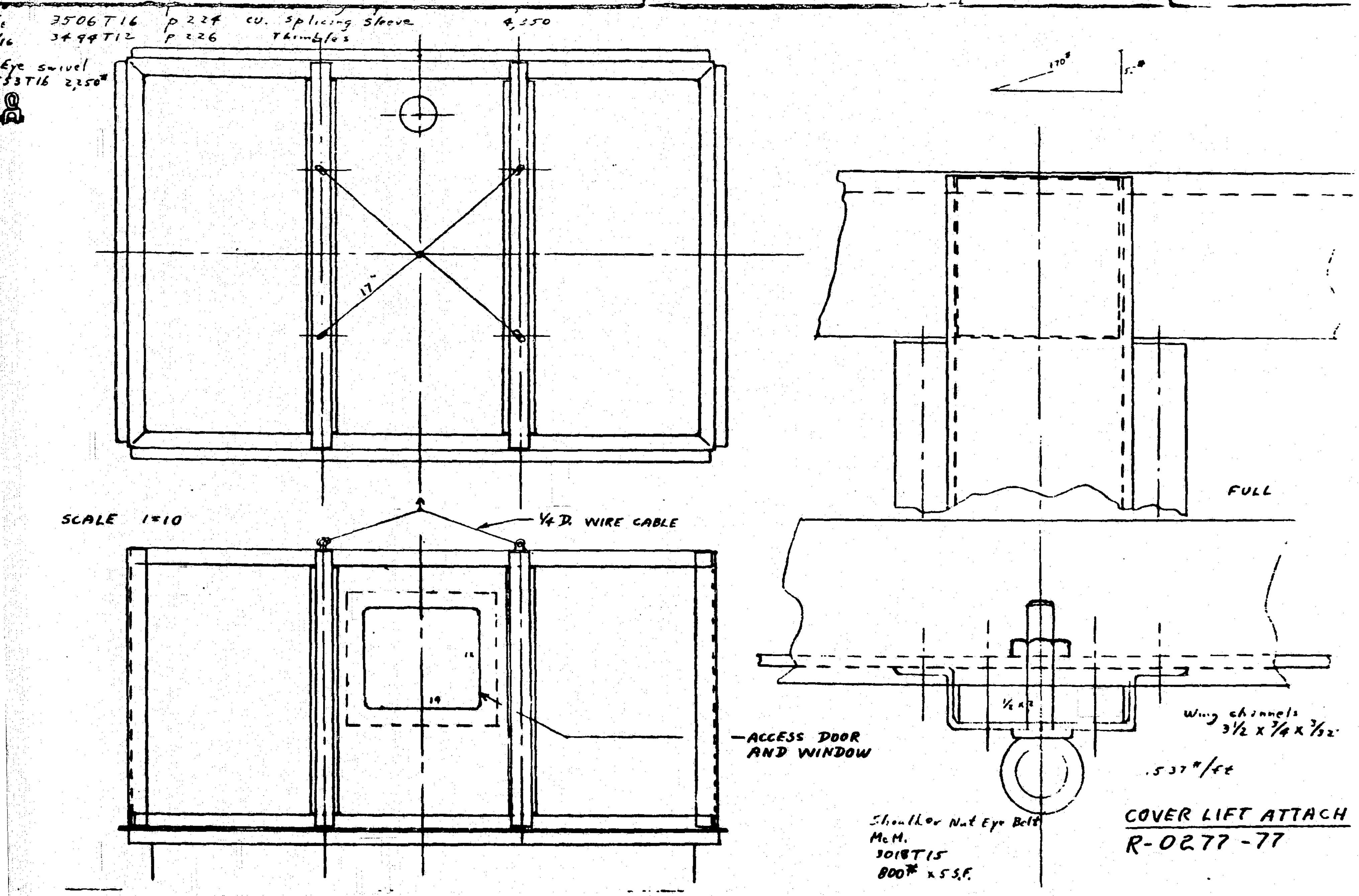


DETAIL B
SK033177-7
4/26/77
M Lincoln
5612


LIFT
CABLE
34"
LIFT
34"
COVER
9"
OPENED
15"
CLOSED
WORM WHEEL
WINCH
750# MAX
LIFT.
1/4 WIRE CABLE
COVER/TABLE DIMENSIONS
R-0275-77

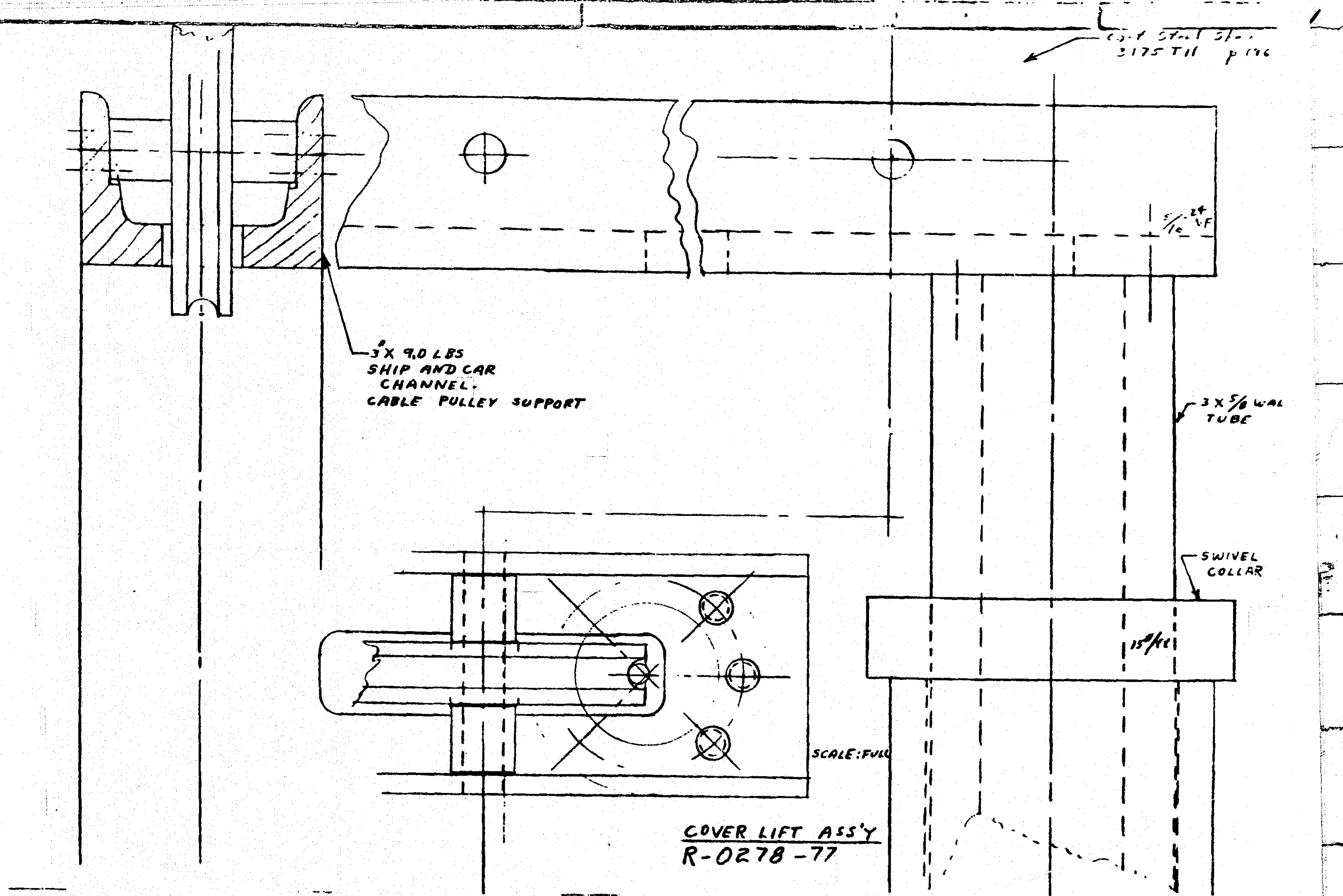


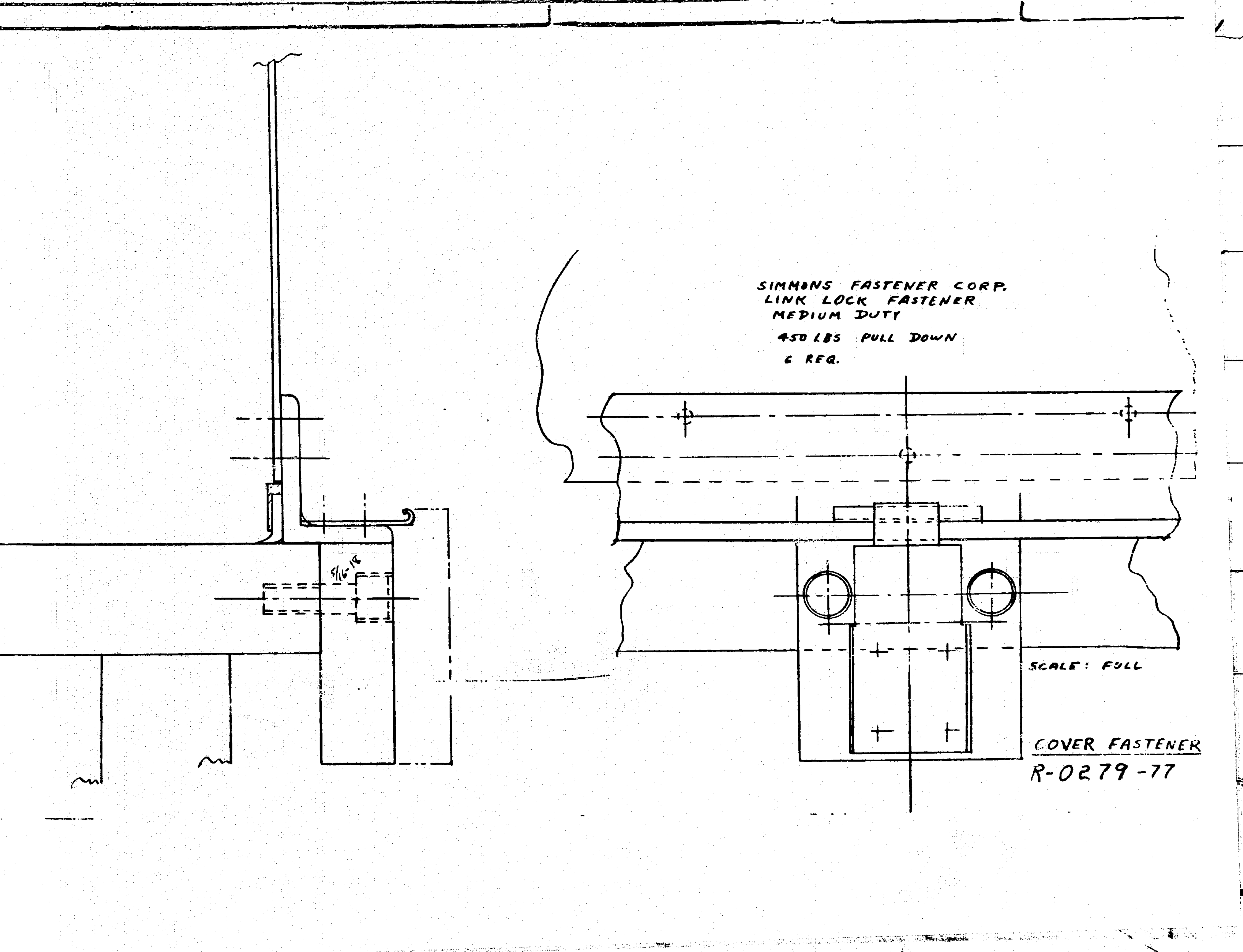
COVER STRUCTURE
R-0276-77



COVER LIFT ATTACH

R-0277-77

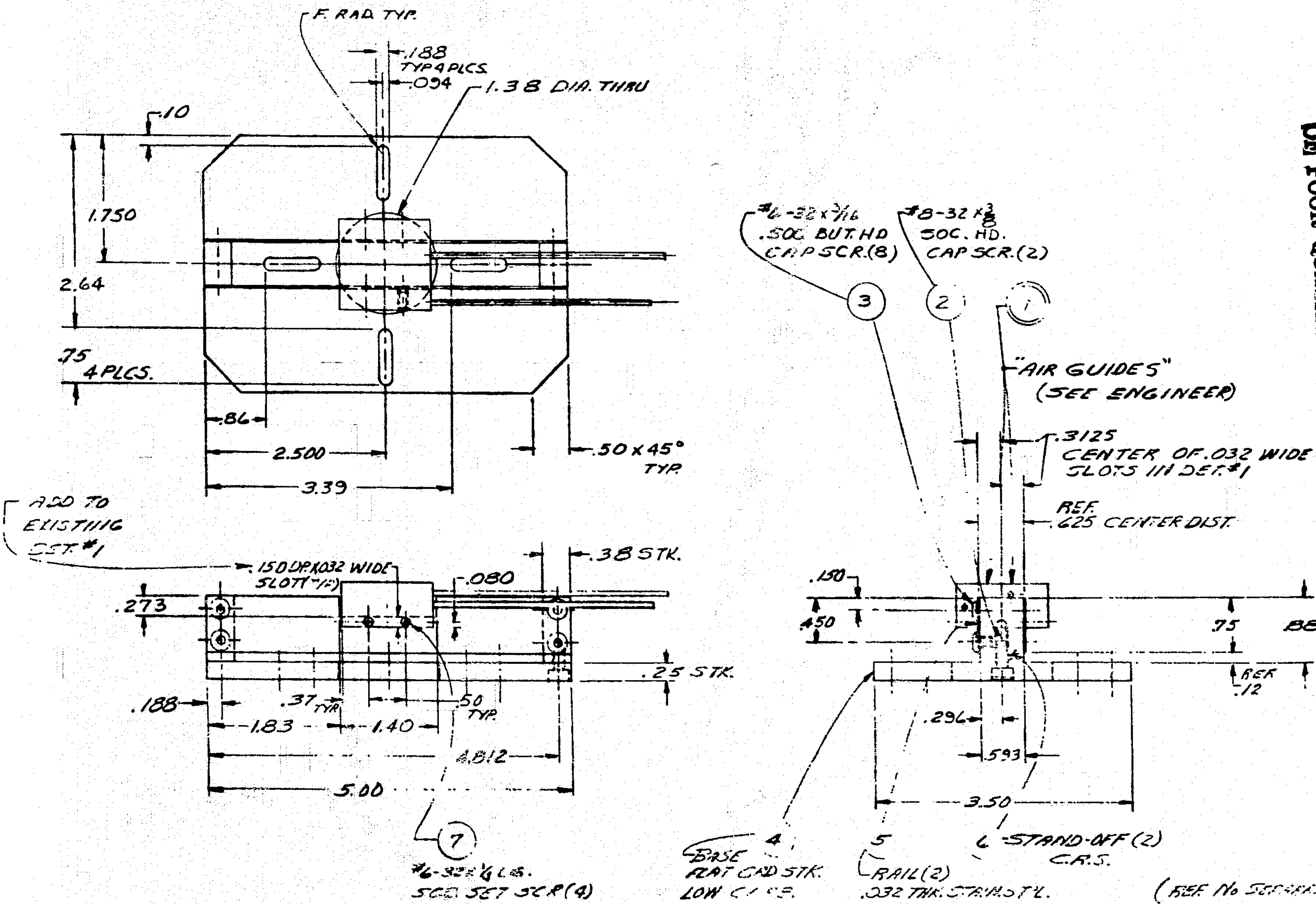

3" X 9.0 LBS
SHIP AND CAR
CHANNEL.
CABLE PULLEY SUPPORT
3 X 5/8 WAL
TUBE
SWIVEL
COLLAR
SCALE: FULL
COVER LIFT ASS'Y
R-0278-77



COVER FASTENER

R-0279-77

REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR



(REF. No SEPARATE PARTS LIST)

UNLESS OTHERWISE SPECIFIED; TOLERANCES:
INCHES .XX ± .010 .XXX ± .005
MILLIMETERS .X ± — .XX ± —
ANGULAR ± 1°
63 RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE.
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: SEE FACE OF DWG.
HEAT TREAT
APPLIED FINISH
DRAWN BY A. PELLETIER DATE
CHECKED BY DATE
ENGR. APPROVAL DATE

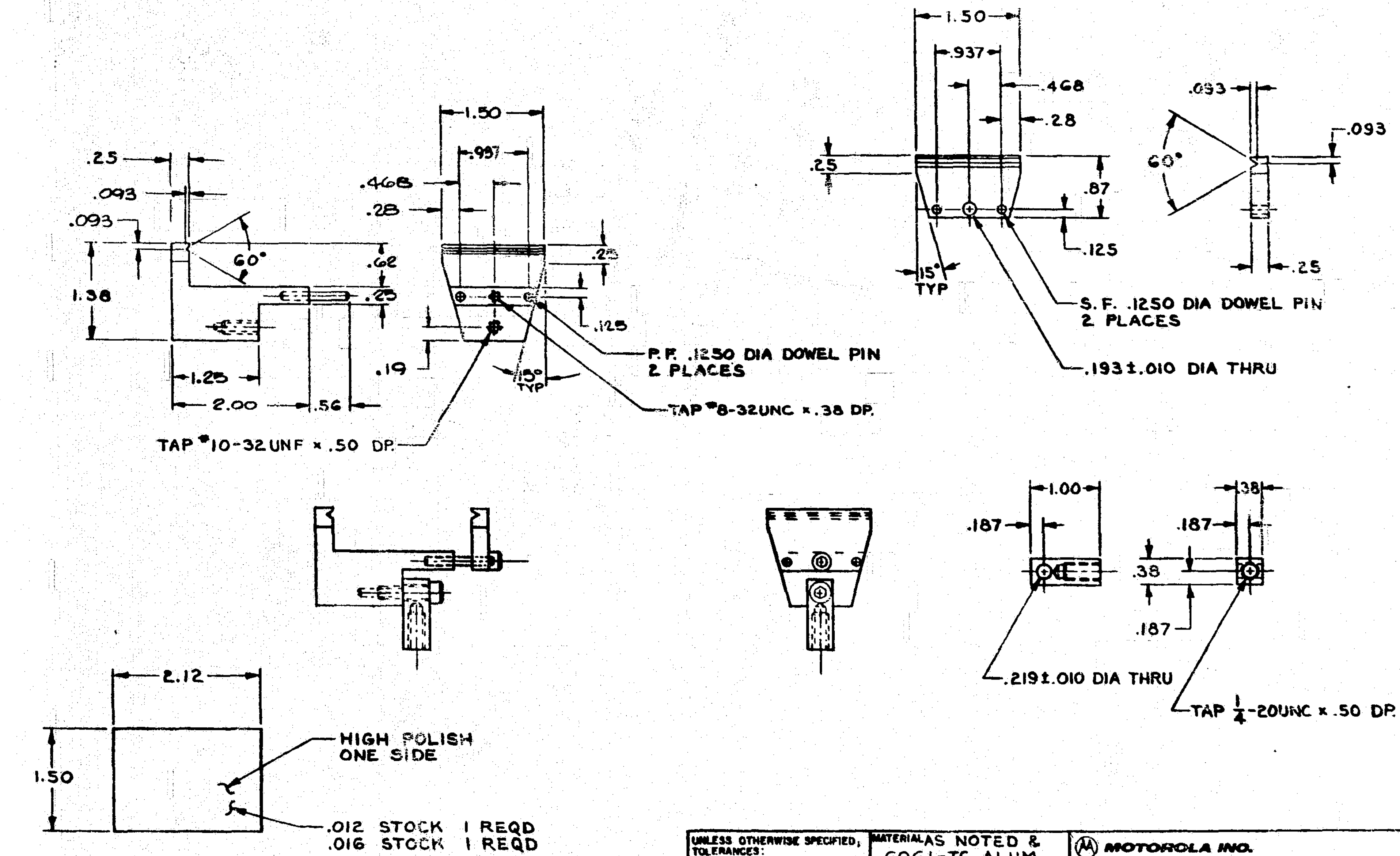
MOTOROLA INC.
Discrete Semiconductor Division

TITLE: ADAPTOR, AIRGUIDE - SINGLE CRYSTAL (ASSY)

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	SK 465-77-143

SCALE FULL | WEIGHT — | SHEET 1 OF 1

NEXT ASSEMBLY	USED ON
APPLICATION	



MAT'L: TYPE 302 OR 304 S.S.

REVISIONS					
REV.	ECO NO	CHANGE	DATE	BY	ENGR

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± .02 .XXX ± .005
MILLIMETERS .X ± .XX ±
ANGULAR ±
√ RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE.
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

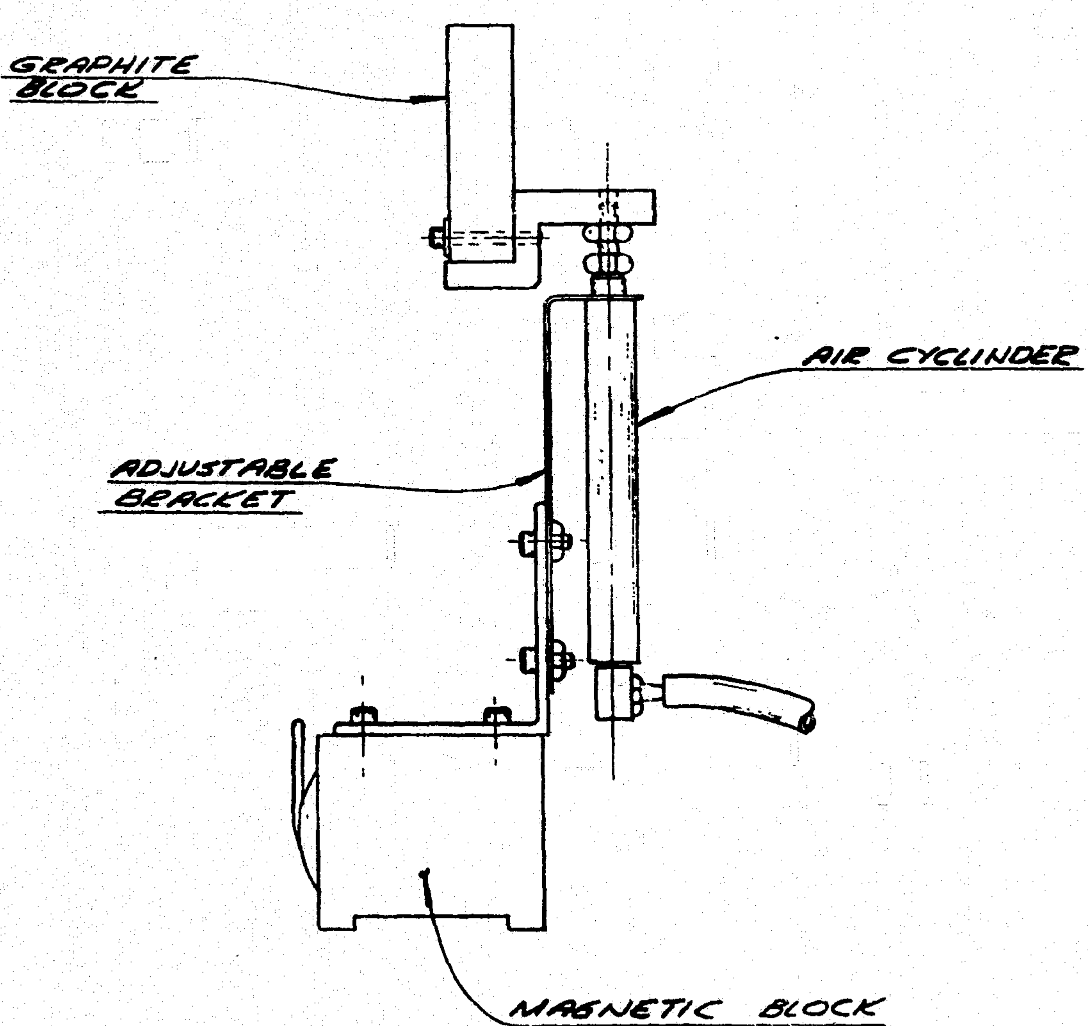
MATERIAL	AS NOTED & 6061-T6 ALUM
HEAT TREAT	
APPLIED FINISH	
DRAWN BY D. DOSS / K. TROUP	DATE 5-20-77
CHECKED BY	DATE
ENGR. APPROVAL	DATE

MOTOROLA INC.
Discrete Semiconductor Division

TITLE: BEAM DEFLECTOR

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	R-0269-77-0
SCALE 1/1	WEIGHT	SHEET OF

REVISIONS					
REV.	ECO NO	CHANGE	DATE	BY	ENGR.



	NEXT ASSEMBLY	USED ON
	APPLICATION	

UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± —, .XXX ± —
MILLIMETERS .X ± —, .XX ± —
ANGULAR — ±
√ RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

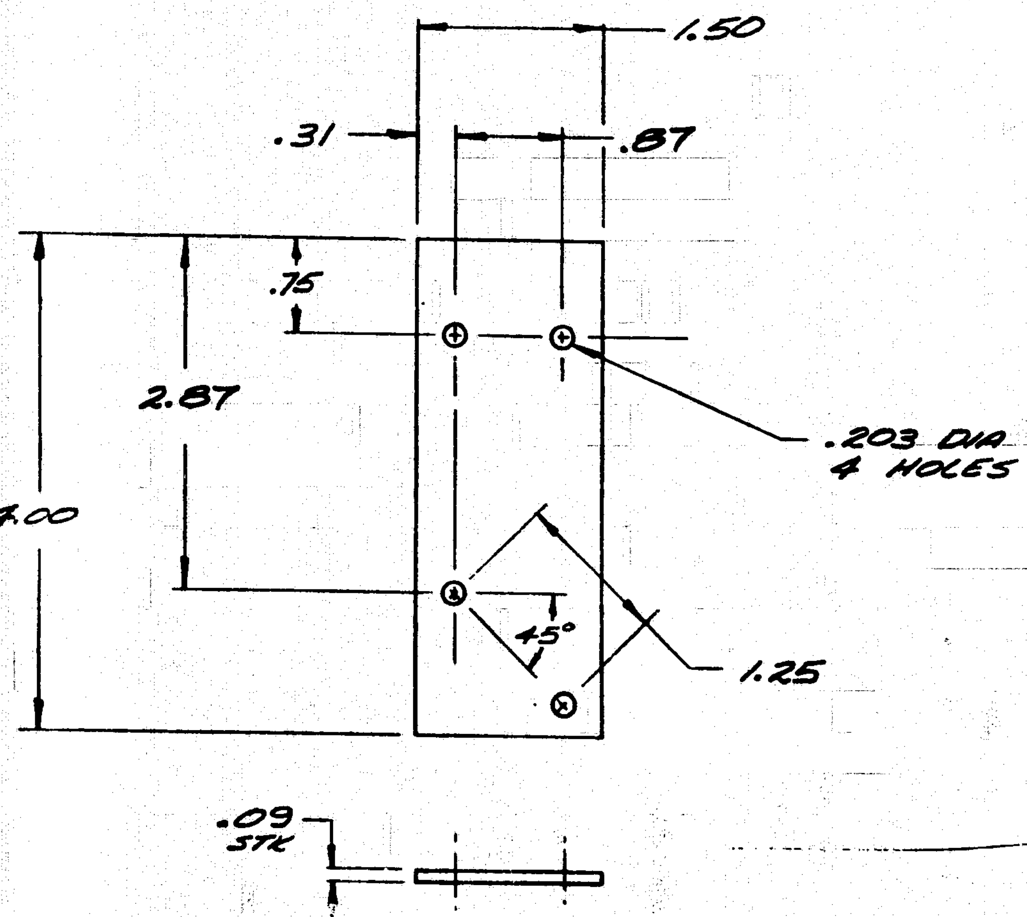
MATERIAL	
HEAT TREAT	
APPLIED FINISH	
DRAWN BY G. BUDAY	DATE
CHECKED BY	DATE
ENGR. APPROVAL	DATE

MOTOROLA INC.
Discrete Semiconductor Division

TITLE: SHUTTER ASS'Y

SIZE	CODE IDENT. NO.	DRAWING NO
C	04713	R-0255-77

SCALE FULL | WEIGHT | SHEET OF



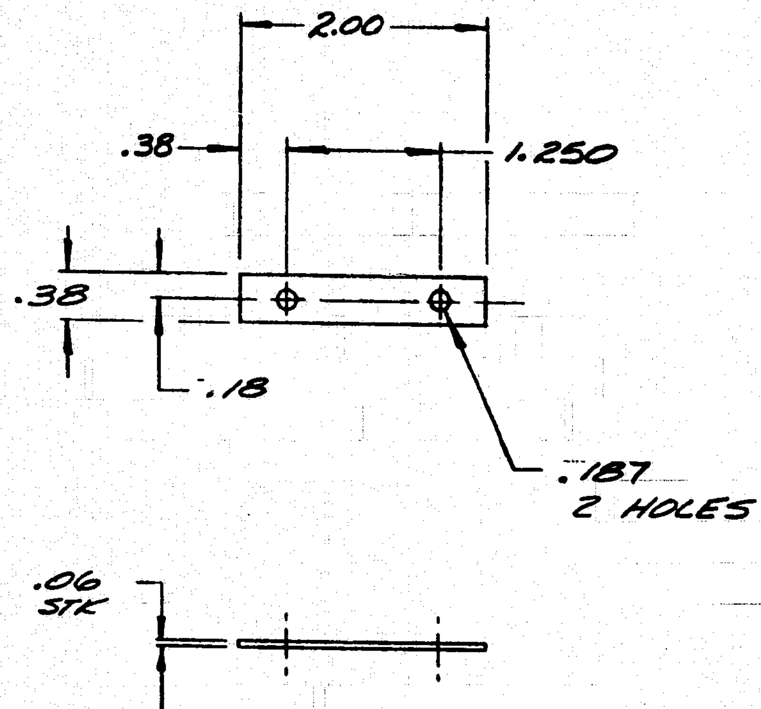
BRACKET- VALVE

TOL - .XX ± .02
.XXX ± .005

MAT'L - ALUM .09 THICK

GLEN BUDAY 4-22-77

R0255-77-6

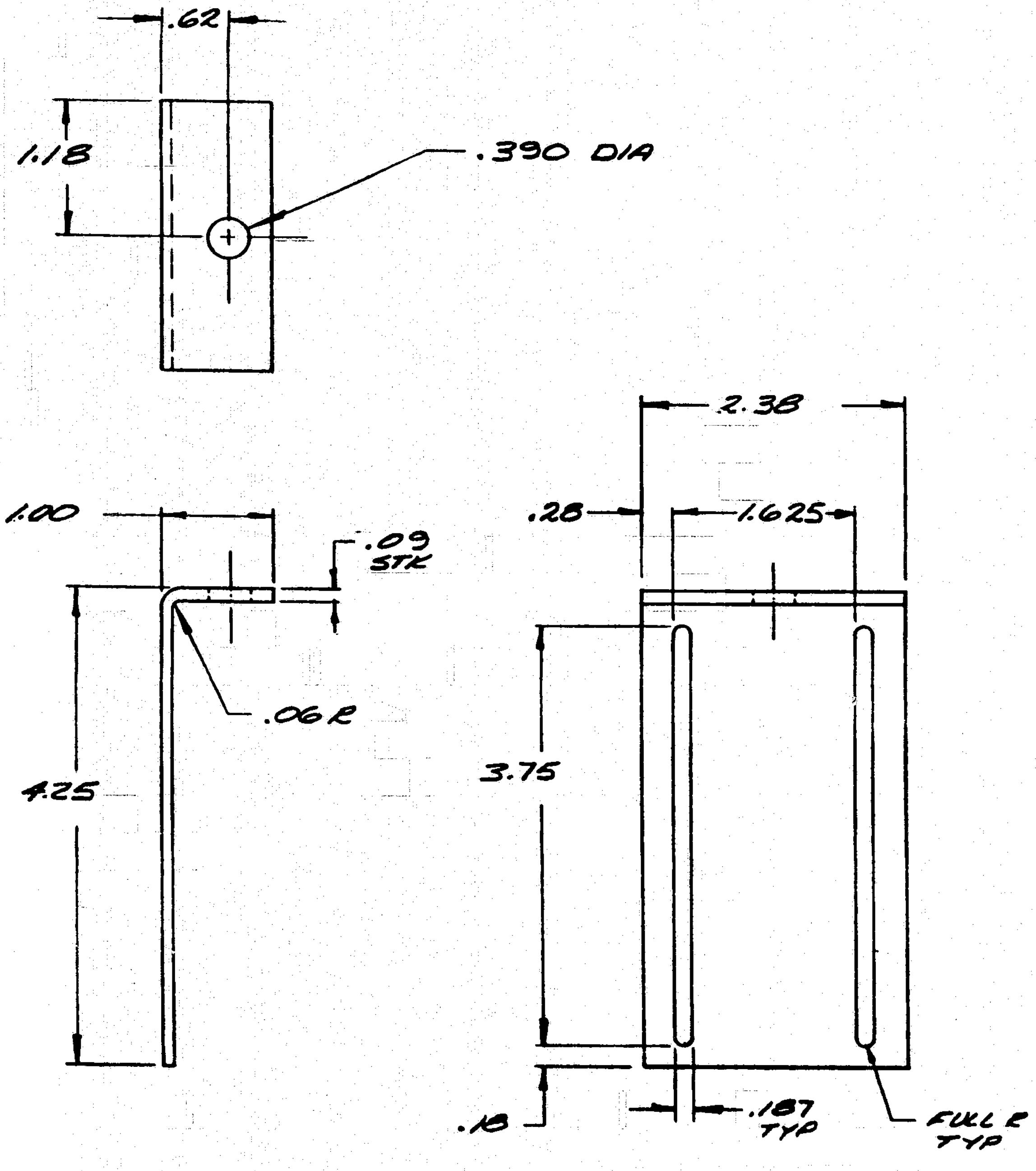


NOTE - BREAK ALL CORNERS

CLAMP

TOL. .XX ±.02
.XXX ±.005
MAT'L - STN STL
DRAWN BY - G. BUDAY 4-21-77

R-0255-5



NOTE - BREAK ALL CORNERS

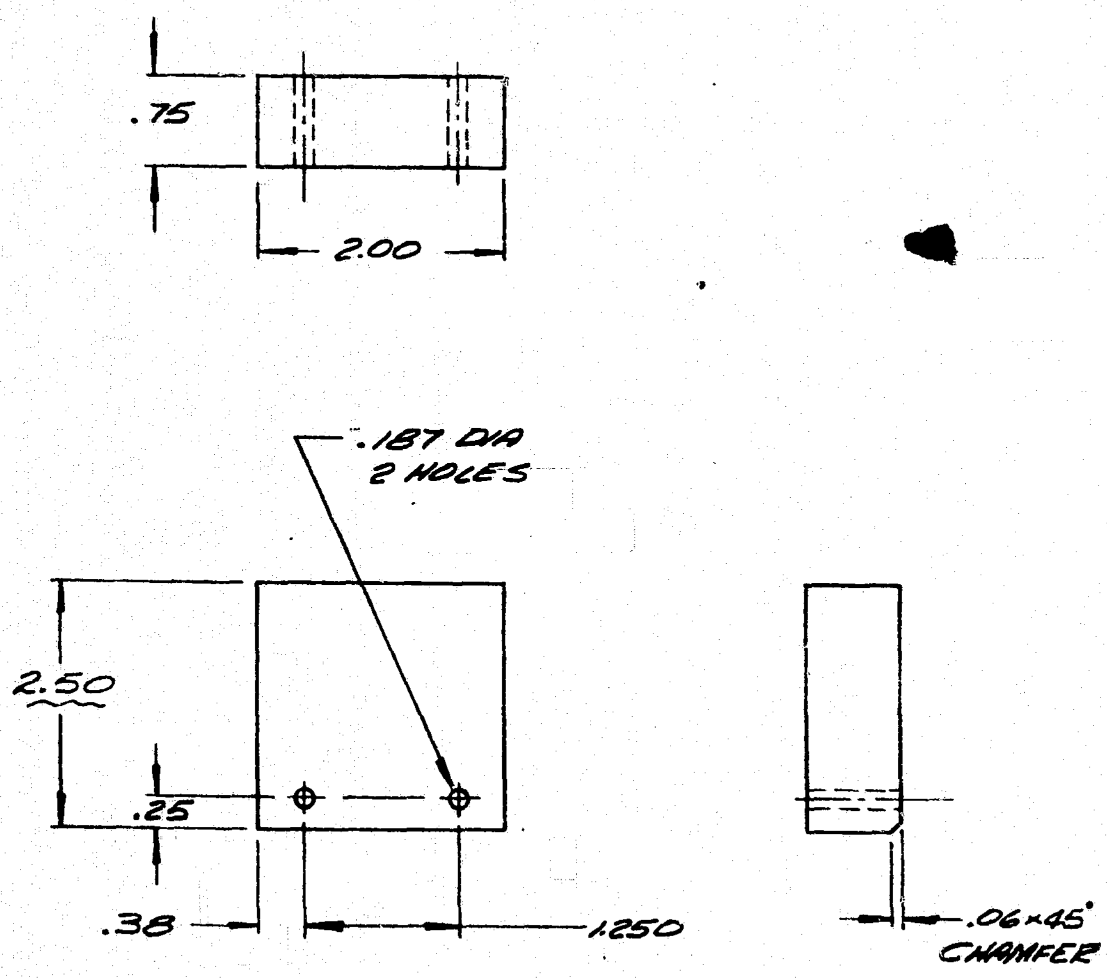
MOUNTING BRACKET
CYLINDER

TOL. .XX ± .02
.XXX ± .005

MAT'L - ALUM 5052H-32
.09 THICK

DRAWN BY - G. BUDAY 4-21-77

R-0255-77-4



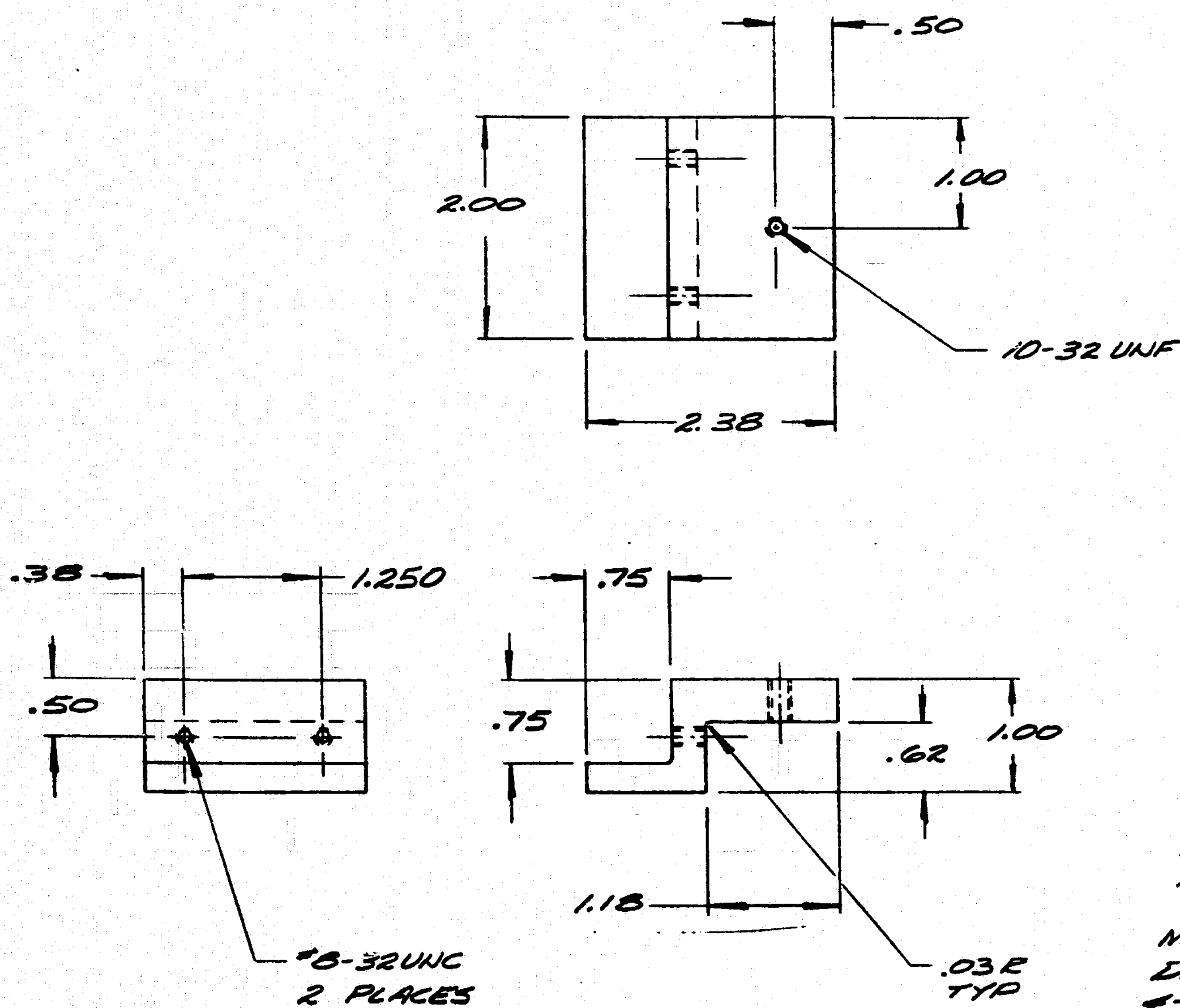
SHIELD LASER

TOL - .xx ±.02
.xxx ±.005

MAT'L - GRAHITE

DRAWN BY - G. BUDAY 4-21-77

R-0255-77-3



NOTE: BREAK ALL CORNERS

SUPPORT BLOCK

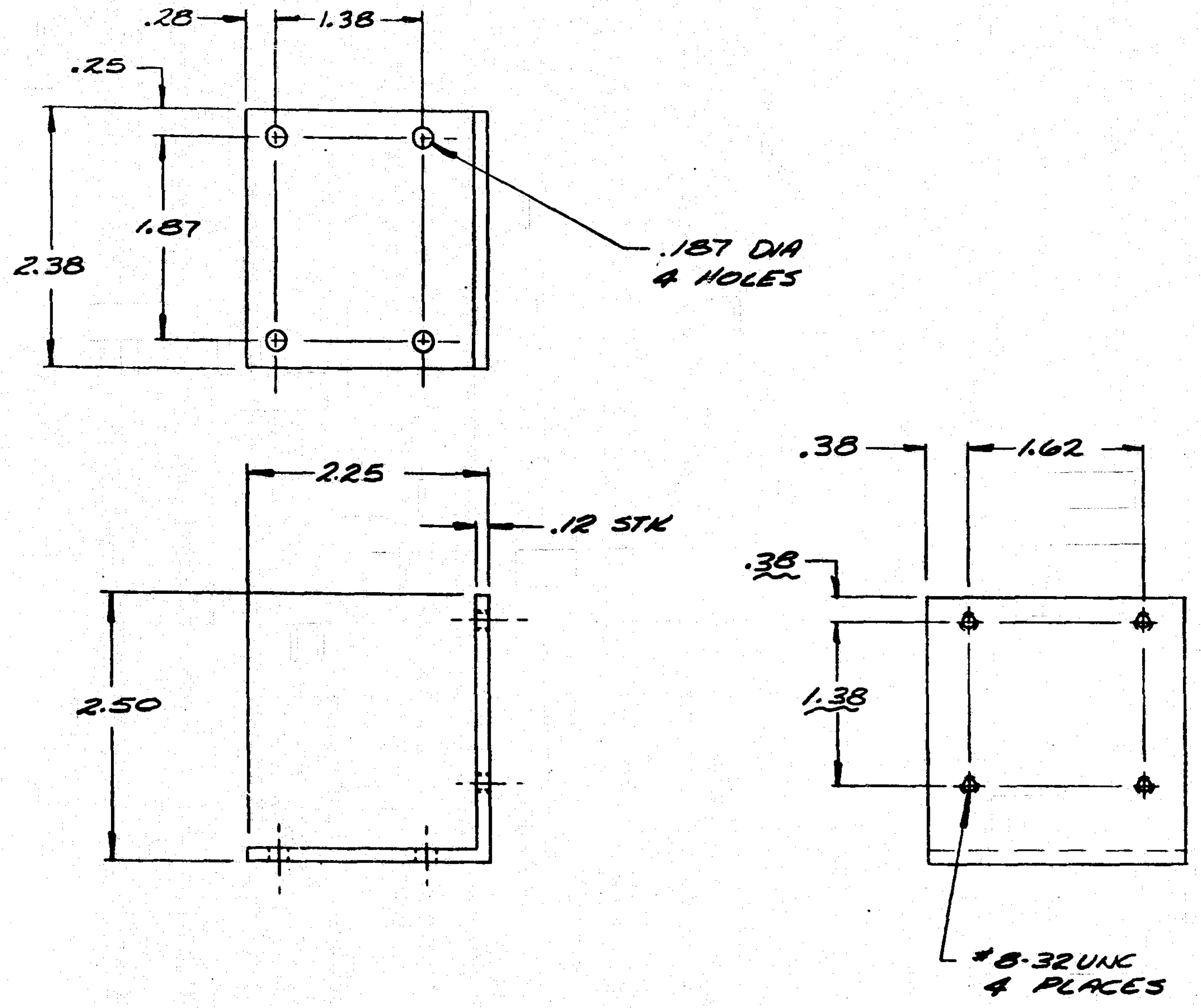
TOL .XX ±.02
.XXX ±.005

MAT'L - ALUM 6061-T6

DRAWN BY - G. BUDAY

4-21-77

R-0255-77-2

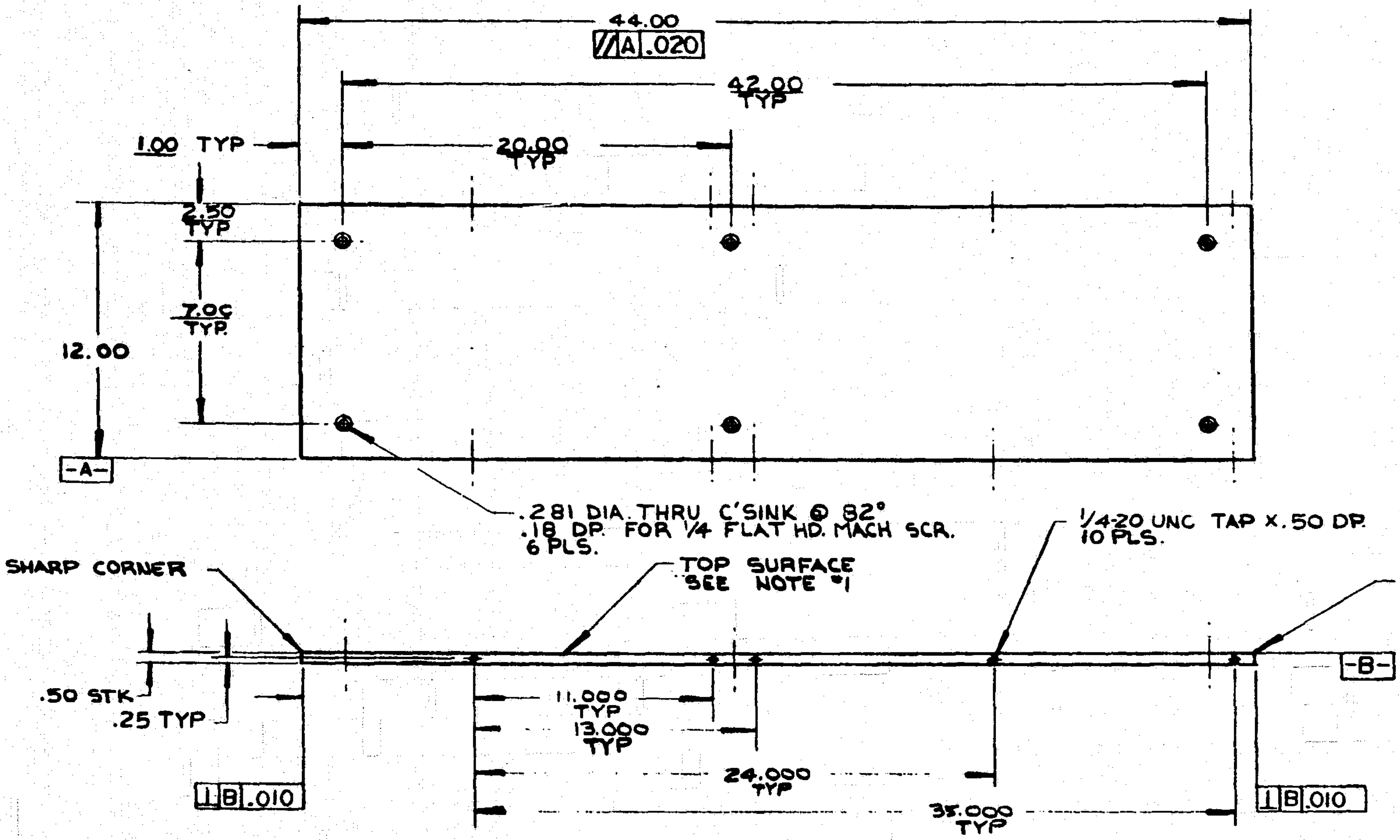


NOTE : BREAK ALL SHARP CORNERS

BRACKET- MAGNETC
BLOCK

TOL-.XX ±.02 .XXX ±.005	MAT'L- ALUM ANGLE 1/8" THICK SHARP CORNERS MOTOROLA STK
G. BUDAY 4-21-77	
R-0255-77-1	

REV.	ECO NO	CHANGE	DATE	BY	ENGR



1. BLANCHARD GRIND FINISH. (TOP SURFACE ONLY) BEAD OR SAND BLAST AFTER GRINDING.

NOTE:

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± .02 .XXX ± .005
MILLIMETERS .X± .XX±
ANGULAR ±
√ RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: COLD ROLLED STEEL
HEAT TREAT: —
APPLIED FINISH: SEE NOTE #1
DRAWN BY R. KASSNER II — DATE 5-24-7?
CHECKED BY — DATE
ENGR. APPROVAL — DATE

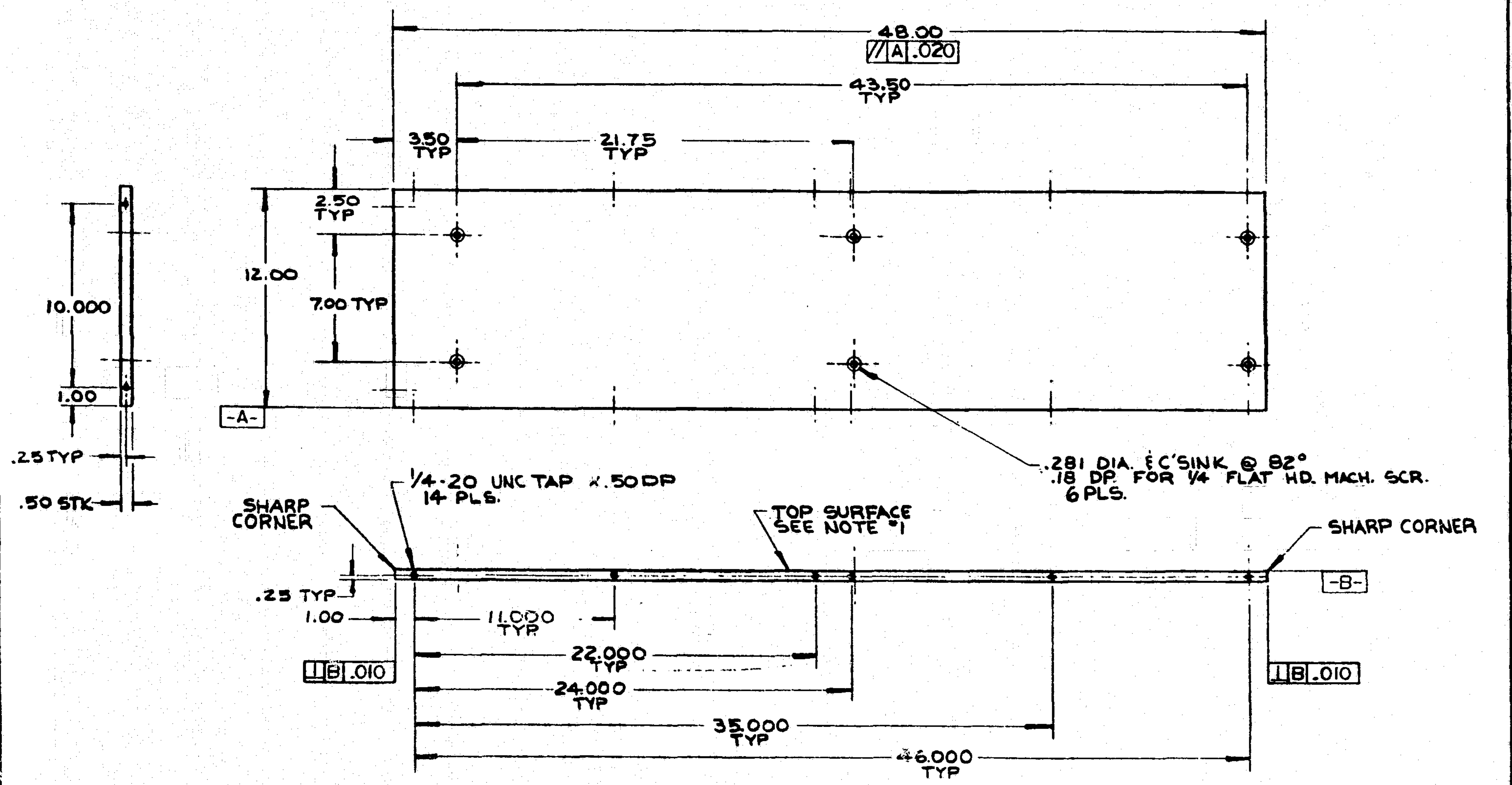
MOTOROLA INC.
Discrete Semiconductor Division

TITLE: TABLE TOP MIDDLE SECTION

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	R-0272-77-3

SCALE 1/4 | WEIGHT | SHEET OF 1

REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR

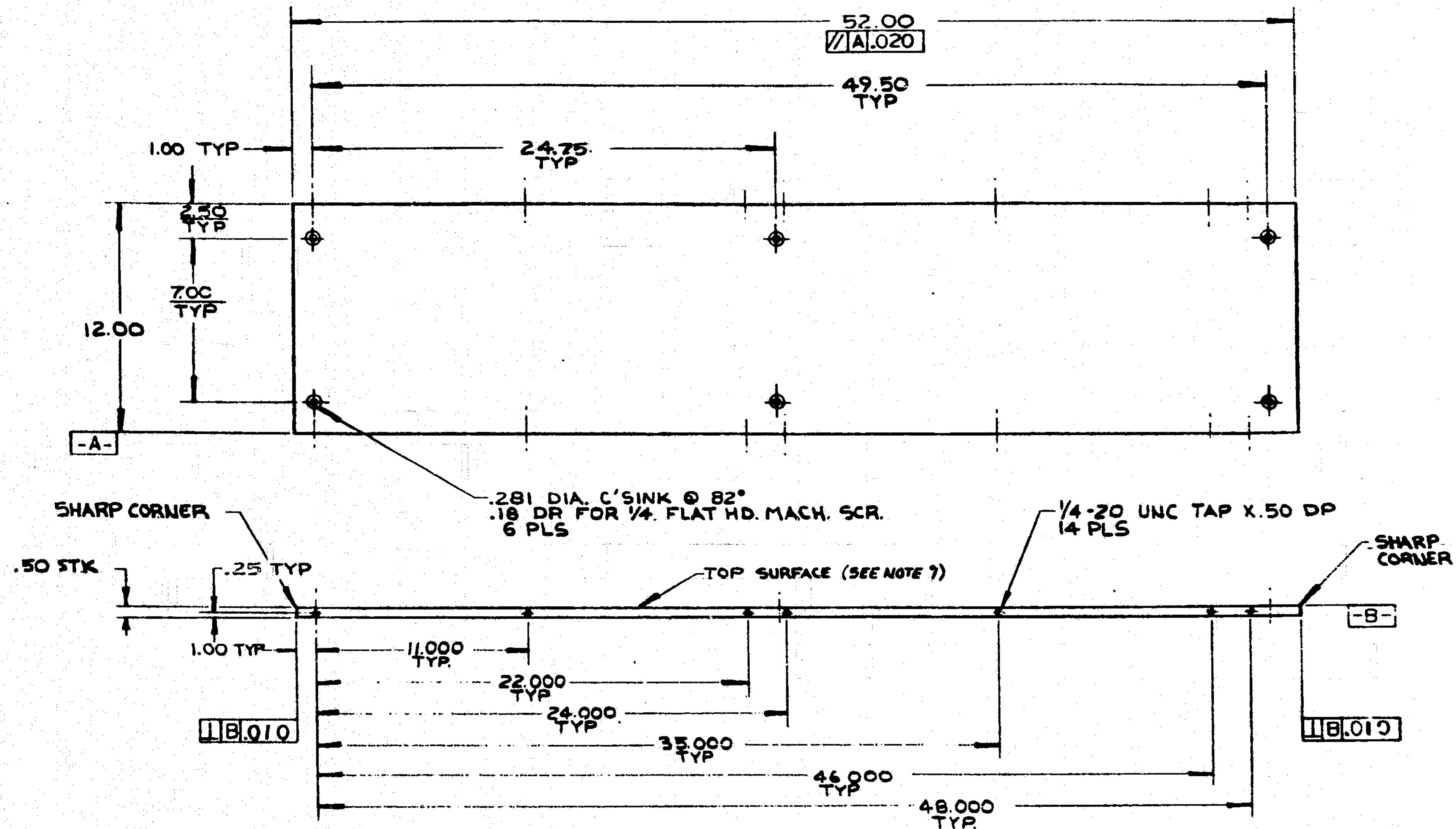


NOTES:
1. BLANCHARD GRIND FINISH (TOP SURFACE ONLY). BEAD OR SAND BLAST AFTER GRINDING.

UNLESS OTHERWISE SPECIFIED, TOLERANCES INCHES XX ±.02 .XXX ±.005 MILLIMETERS .X ± .XX ± ANGULAR ± RMS ALL MACHINED SURFACES FEATURE CONTROL SYMBOLS PER ANSI Y14.5 BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS. UNDERLINED DIM NOT TO SCALE. THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.	MATERIAL COLD ROLLED STEEL	MOTOROLA INC. Discrete Semiconductor Division
	HEAT TREAT	TITLE: TABLE TOP RIGHT/LEFT SIDE
	APPLIED FINISH SEE NOTE #1	
	DRAWN BY R.KASSNERT DATE 5-23-7?	SIZE C CODE IDENT. NO. 04713 DRAWING NO R-0272-77-1
	CHECKED BY DATE	
	ENGR. APPROVAL DATE	SCALE 1/4 WEIGHT SHEET 1 OF 1

NEXT ASSEMBLY	USED ON
APPLICATION	

REV.	ECO NO	CHANGE	DATE	BY	ENGR.



1. BLANCHARD GRIND FINISH (TOP SURFACE ONLY) BEAD OR SAND BLAST AFTER GRINDING.

NOTE:

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED; TOLERANCES:
INCHES .XX ± .02 .XXX ± .005
MILLIMETERS .X ± — .XX ± —
ANGULAR ± —
RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: COLD ROLLED STEEL
HEAT TREAT: —
APPLIED FINISH: SEE NOTE #1
DRAWN BY: R KASSNER II — DATE: 5-23-77
CHECKED BY — DATE
ENGR. APPROVAL — DATE

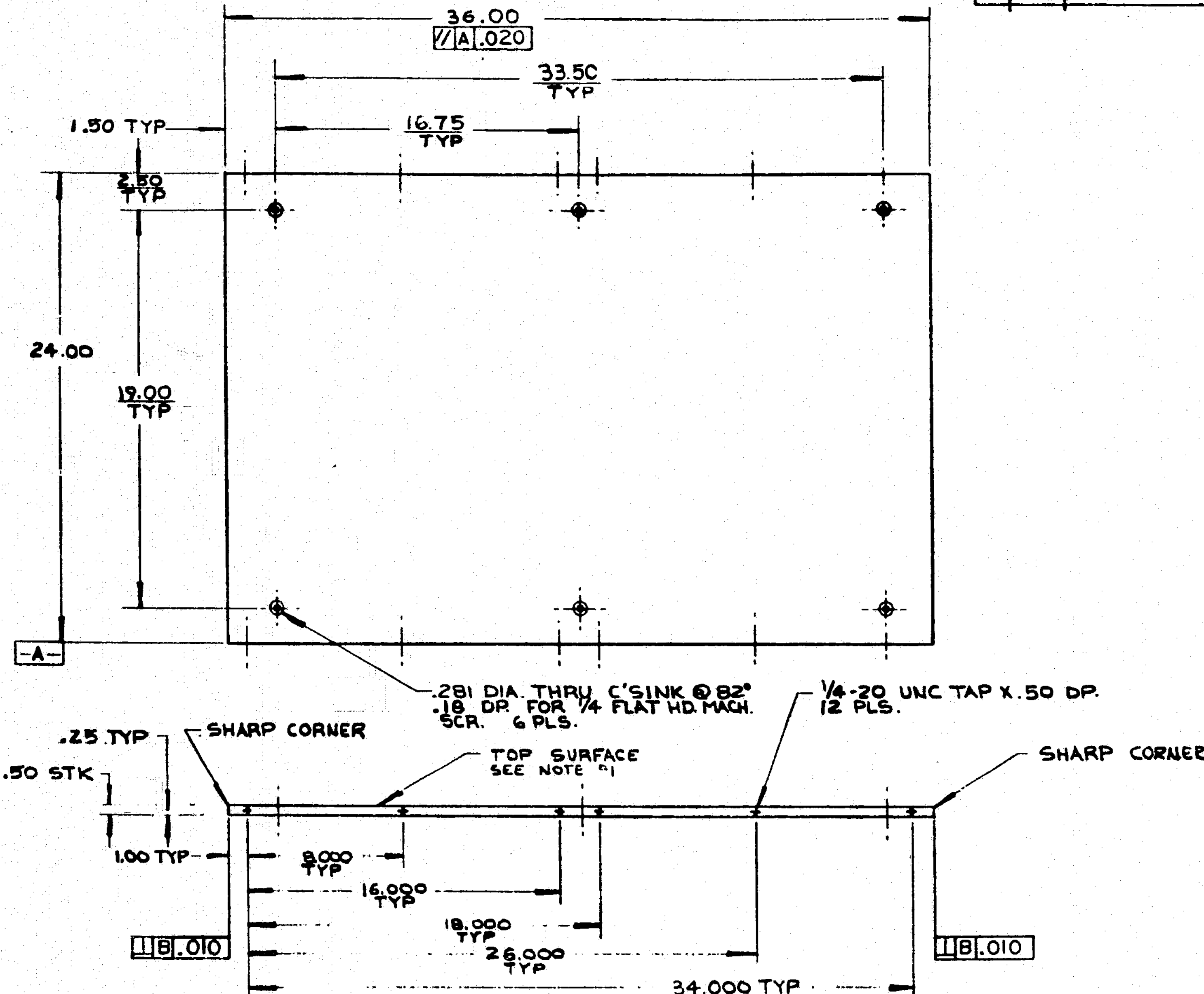
MOTOROLA INC.
Discrete Semiconductor Division

TITLE: TABLE TOP MIDDLE SECTION

SIZE	CODE IDENT. NO.	DRAWING NO
C	04713	R-0272-77-2

SCALE 1/4 | WEIGHT | SHEET 1 OF 1

REVISIONS					
REV.	ECO NO	CHANGE	DATE	BY	ENGR

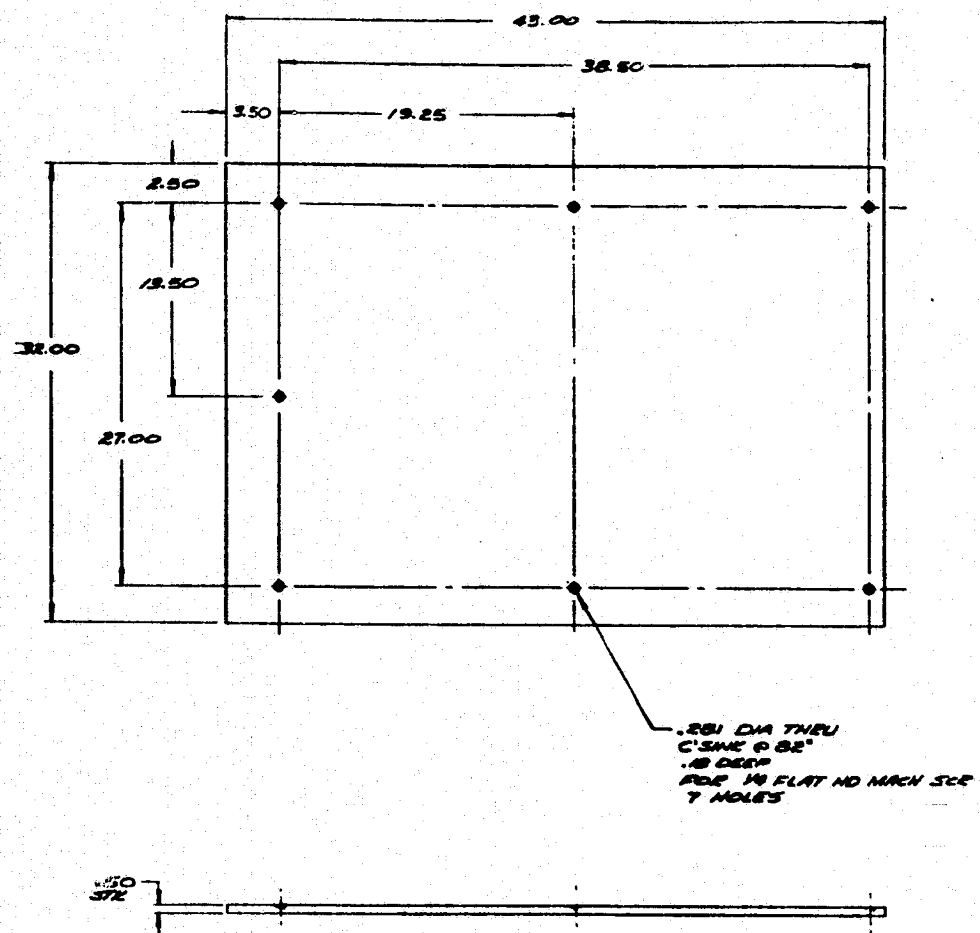


1. BLANCHARD GRIND FINISH (TOP SURFACE ONLY) BEAD OR SAND BLAST AFTER GRINDING.

NOTE:

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED, TOLERANCES: INCHES .XX ± .02 .XXX ± .005 MILLIMETERS .X ± / .XX ± - - - ANGULAR ± / / √ RMS ALL MACHINED SURFACES FEATURE CONTROL SYMBOLS PER ANSI Y14.5 BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS. UNDERLINED DIM NOT TO SCALE THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.	MATERIAL COLD ROLLED STEEL		MOTOROLA INC. Discrete Semiconductor Division	
	HEAT TREAT / /		TITLE: TABLE TOP CENTER MIDDLE SECTION	
	APPLIED FINISH SEE NOTE #1			
	DRAWN BY R. KASSNER II	DATE 5-24-77	SIZE C	CODE IDENT. NO. 04713 / DRAWING NO. R-0272-77-4
	CHECKED BY	DATE		
	ENGR. APPROVAL	DATE	SCALE 1/4	WEIGHT / SHEET 1 OF 1



MATERIAL: C.R.S.

HEAT TREAT

APPLIED FINISH

UNLESS OTHERWISE SPECIFIED, TOLERANCES

NEXT ASSEMBLY | USED ON

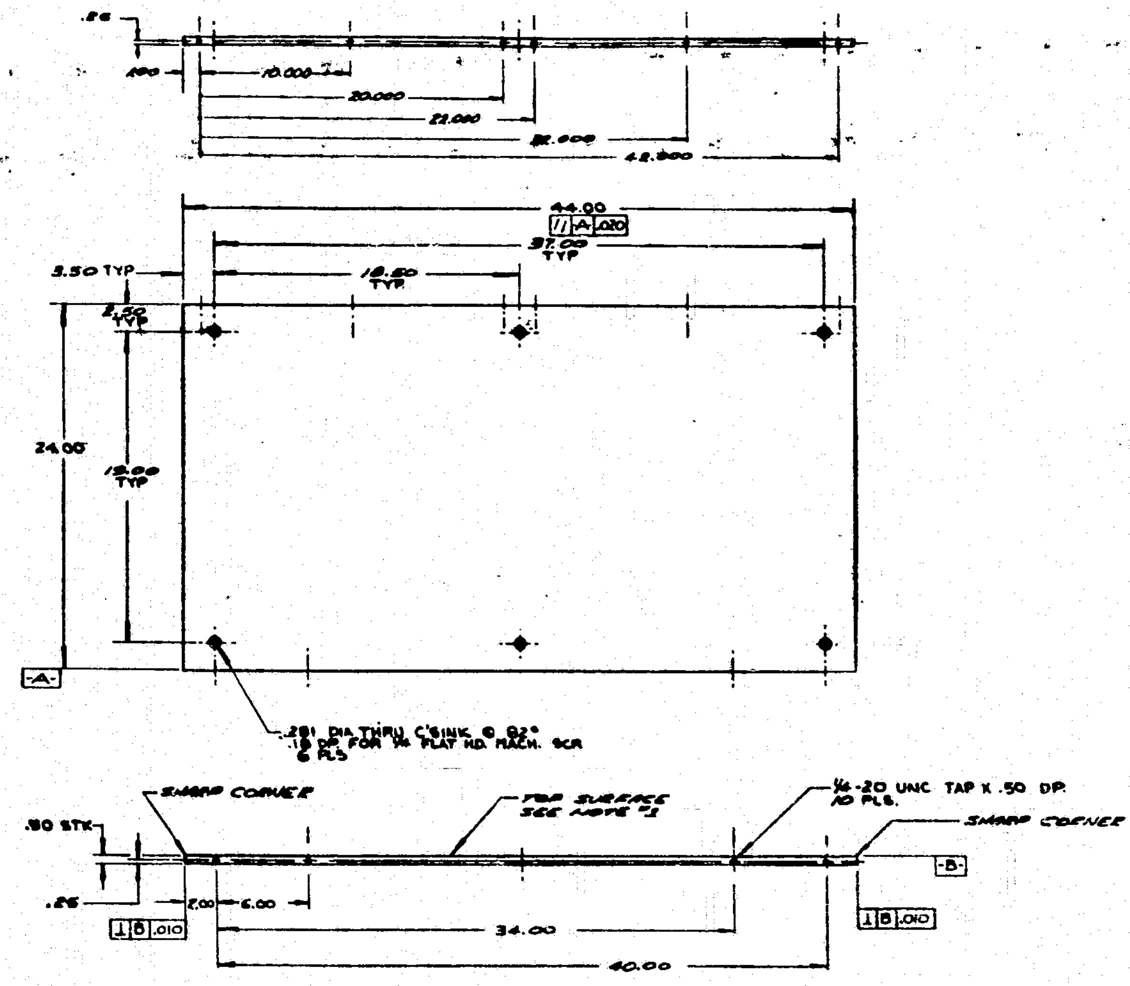
APPLICATION

MOTOROLA INC.
Discrete Semiconductor Division

TITLE: TABLE TOP FOR YAG LASER

SIZE: D | CODE IDENT NO. 04713 | DRAWING NO. E-0272-77-6

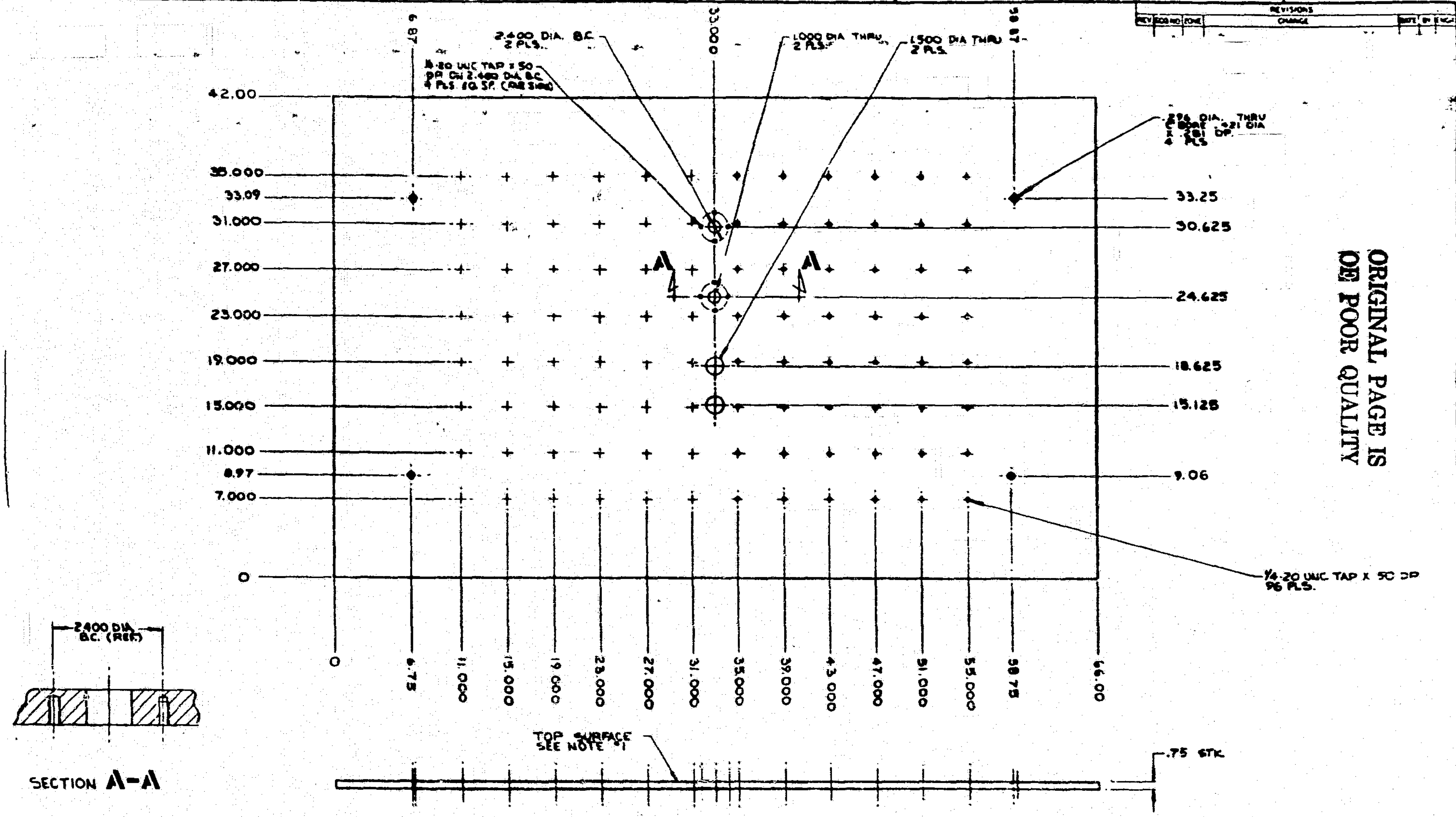
SCALE 1:4 | WEIGHT | SHEET



NOTES:

1- BLANCHARD GRIND FINISH (TOP SURFACE ONLY). BEAD OR SAND BLAST AFTER GRINDING.

MATERIAL	C.R.S.
HEAT TREAT	/ /
APPLIED FINISH	SEE NOTE #1
	MOTOROLA INC. Discrete Semiconductor Division
TITLE:	TABLE TOP FRONT SECTION
SIZE	B
CODE IDENT. NO.	04713
DRAWING NO.	E-0272-77-5
SCALE	1/4
SHEET	1 OF 1

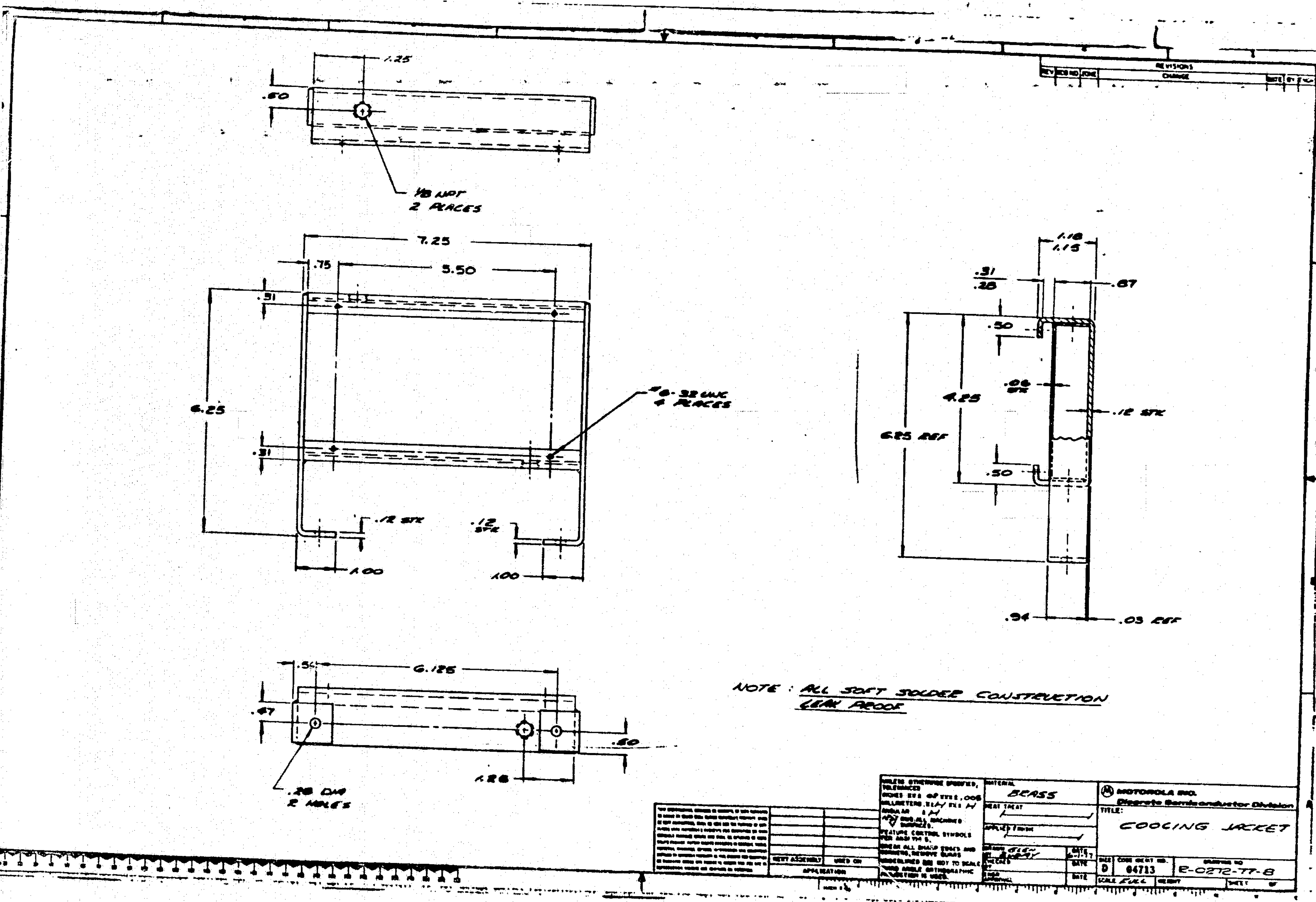


1. BLANCHARD GRIND FINISH (TOP SURFACE ONLY) BEAD OR SAND BLAST AFTER GRINDING.

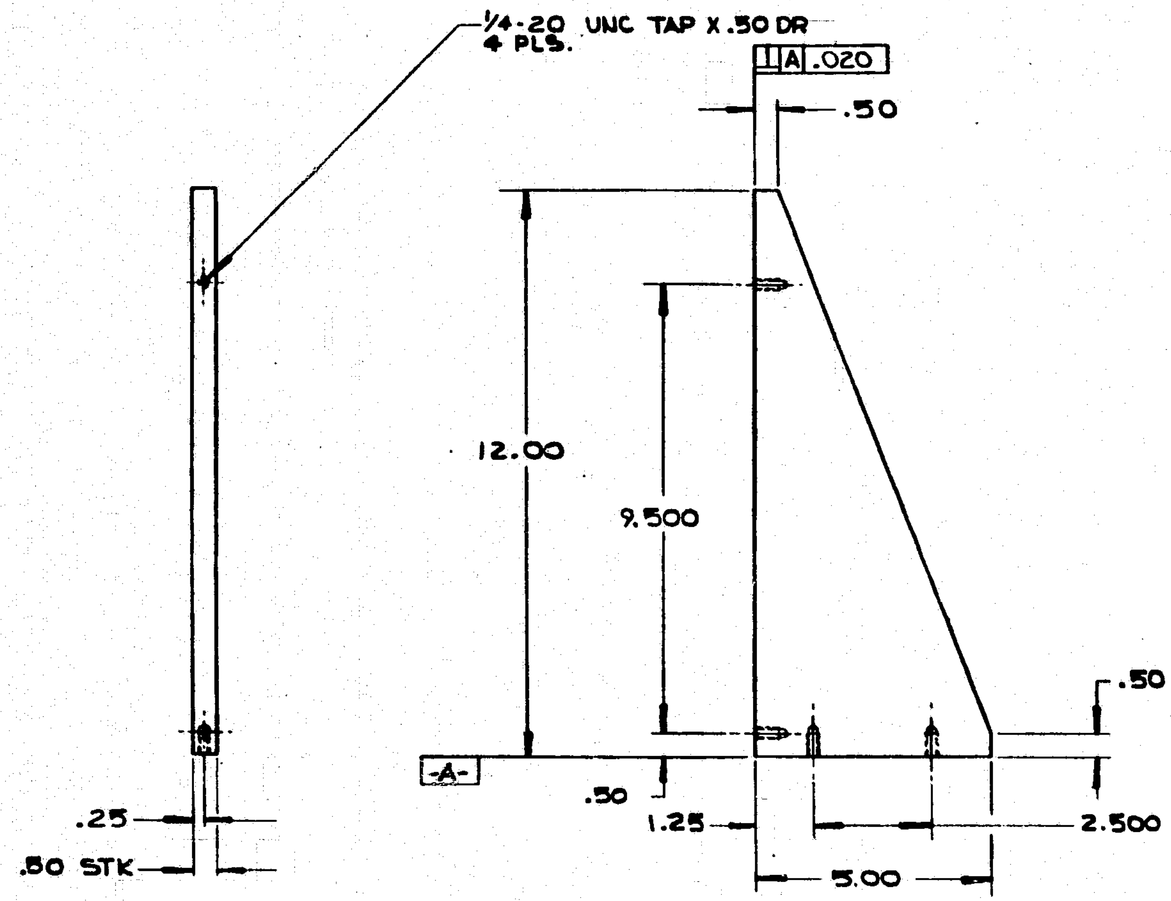
NOTE:

MATERIAL	COLD ROLLED STEEL
HEAT TREAT	
APPLIED FINISH	SEE NOTE 1
DRAWN BY	KASSNER K.
	MOTOROLA INC. Discrete Semiconductor Division
TITLE:	TABLE TOP-WORK STATION FOR CO_2-400 WATT LASER
SIZE	D
CODE IDENT. NO	84713
DRAWING NO	R-0272-77-7
SCALE	1/4

ORIGINAL PAGE IS OF POOR QUALITY


1.25
.50
1/8 NPT
2 PLACES
7.25
.75
5.50
.31
6.25
#6-32 UNC
4 PLACES
.12 STK
1.00
1.18
1.15
.31
.28
.67
.50
.06 STK
4.25
.12 STK
6.25 REF
.94
.03 REF
.56
6.125
.67
.50
1.26
.28 DIA
2 HOLES
NOTE : ALL SOFT SOLDER CONSTRUCTION
LEAK PROOF
REVISIONS
MATERIAL
BRASS
HEAT TREAT
APPLIED FINISH
NEXT ASSEMBLY
USED ON
APPLICATION
MOTOROLA INC.
Discrete Semiconductor Division
TITLE:
COOLING JACKET
D
64713
E-0272-77-8
SCALE FULL

REV.	ECO NO.	CHANGE	DATE	BY	ENGR.



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± .02 .XXX ± .006
MILLIMETERS .X ± — .XX ± —
ANGULAR ± —
125 RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: 6061-T6 AL.
HEAT TREAT: —
APPLIED FINISH: —
DRAWN BY: R. KASSNER II — DATE: 6-10-72
CHECKED BY: — DATE:
DESIGN APPROVAL: — DATE:

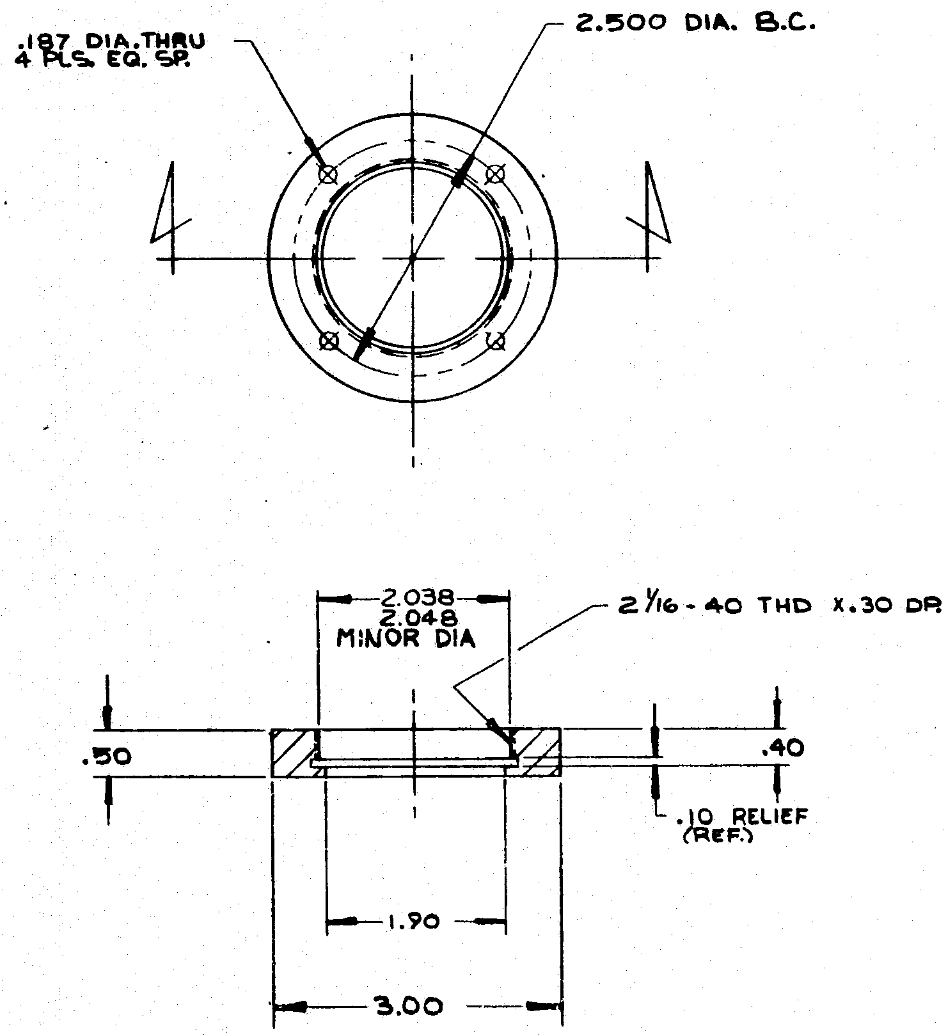
MOTOROLA INC.
Discrete Semiconductor Division

TITLE: SIDE SUPPORT

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	R-0272-77-10

SCALE 1/2 — WEIGHT — SHEET 1 OF 1

REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR.



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED,
TOLERANCES:
INCHES .XX ± .02 .XXX ± .005
MILLIMETERS .X ± / .XX ±
ANGULAR ±
63 RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

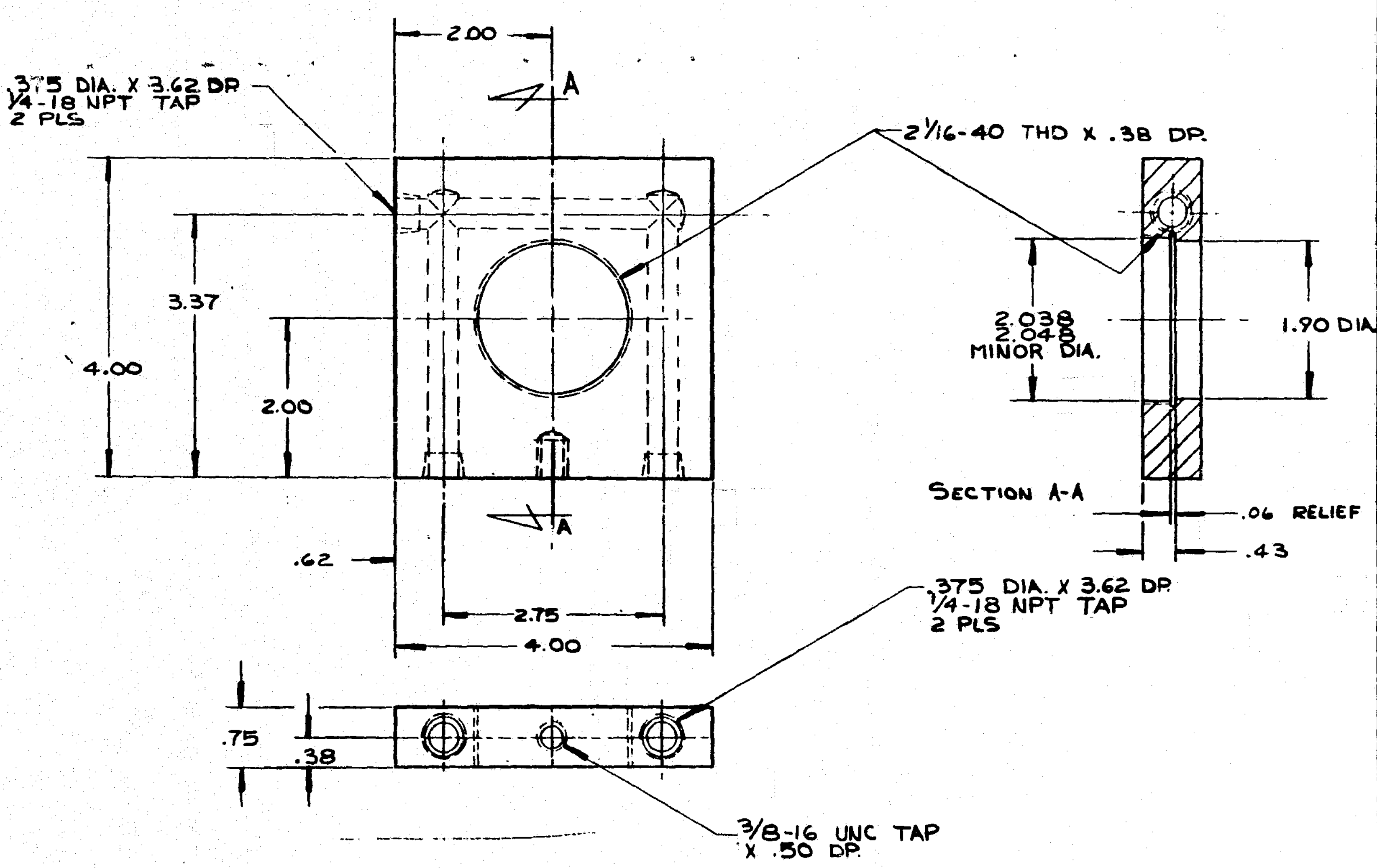
MATERIAL	6061-T6 AL.
HEAT TREAT	
APPLIED FINISH	
DRAWN BY	R.KASSNER III	DATE
CHECKED BY	DATE
ENGR. APPROVAL	DATE

MOTOROLA INC.
Discrete Semiconductor Division

TITLE: WINDOW MOUNT

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	R-0272-77-13
SCALE FULL	WEIGHT	SHEET 1 OF 1

REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR.



[illegible]

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED; TOLERANCES:
INCHES .XX ± .02 .XXX ± .005
MILLIMETERS .X ± — .XX ± —
ANGULAR ± —
63 RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIMS NOT TO SCALE.
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: 6061-T6 AL.
HEAT TREAT: —
APPLIED FINISH: —
DRAWN BY: R KASSNER II — DATE: 6-13-77
CHECKED BY: — DATE:
ENGR. APPROVAL: — DATE:

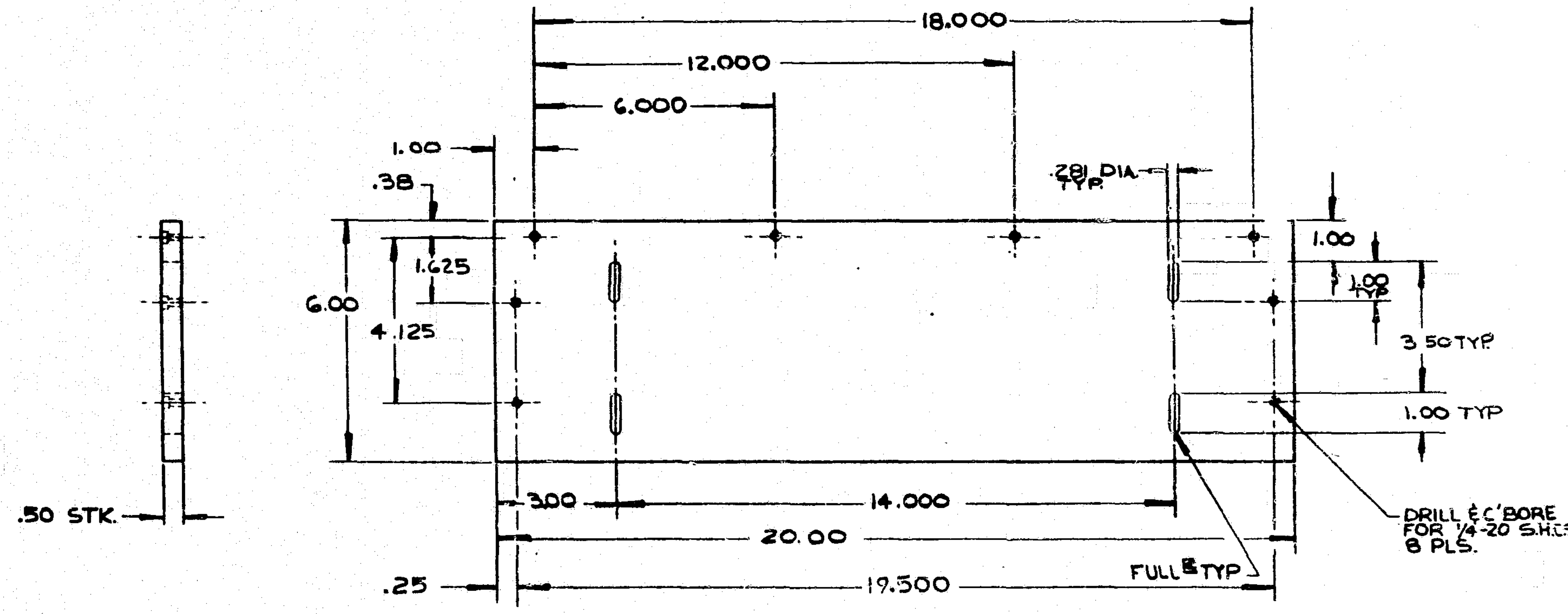
MOTOROLA INC.
Discrete Semiconductor Division

TITLE: COOLING BLOCK FOR LENS

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	R-0272-77-14

SCALE FULL | WEIGHT | SHEET 1 OF 1

REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± .02, .XXX ± .005
MILLIMETERS .X ± — .XX ± —
ANGULAR ± —
125 RMS ALL MACHINED SURFACES
FEATURE CONTROL SYMBOLS PER ANSI Y14.5
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE.
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: 6061-T6 AL.
HEAT TREAT: —
APPLIED FINISH: —
DRAWN BY: R. KASSNER III DATE: 6-10-77
CHECKED BY: DATE:
ENGR. APPROVAL: DATE:

MOTOROLA INC.
Discrete Semiconductor Division

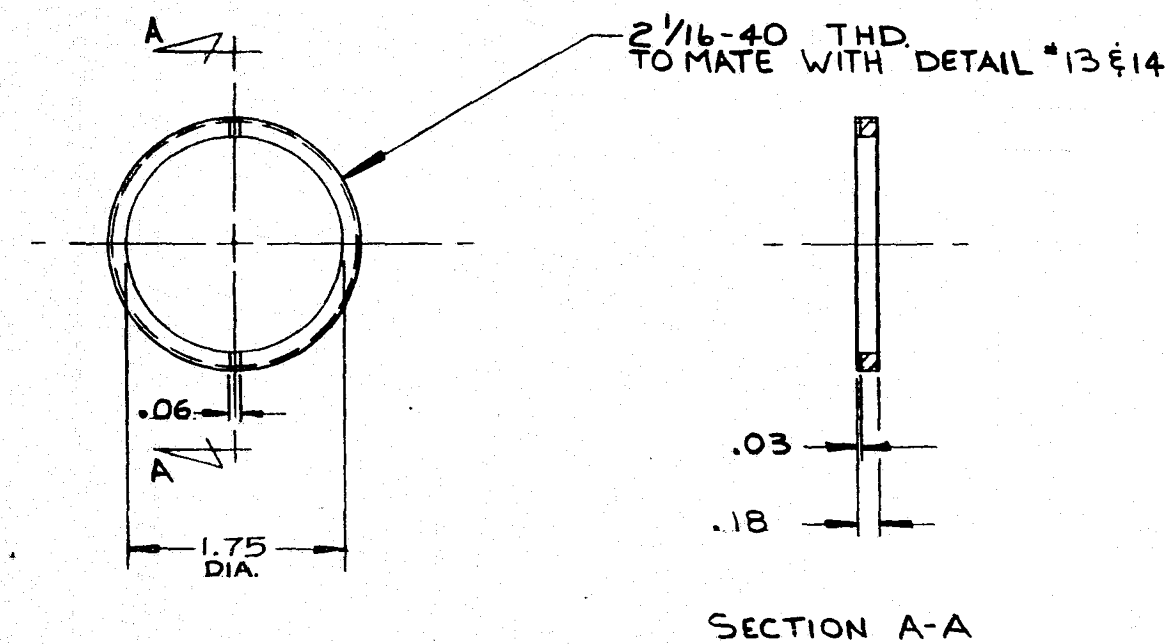
TITLE: BASE PLATE

SIZE	CODE IDENT. NO.	DRAWING NO.
C	04713	R-0272-77-11

SCALE 1/2 | WEIGHT | SHEET 1 OF 1

C-2

REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR.



UNLESS OTHERWISE SPECIFIED, TOLERANCES:
INCHES .XX ± .02 .XXX ± —
MILLIMETERS .X ± — .XX ± —
ANGULAR ± —
63 RMS ALL MACHINED SURFACES.
FEATURE CONTROL SYMBOLS PER ANSI Y14.5.
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE.
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL: 6061-T6 AL.

HEAT TREAT: —

APPLIED FINISH: —

DRAWN BY	R. KASSNER II	DATE	6-8-77
CHECKED BY		DATE	
ENGR. APPROVAL		DATE	

MOTOROLA INC.
Discrete Semiconductor Division

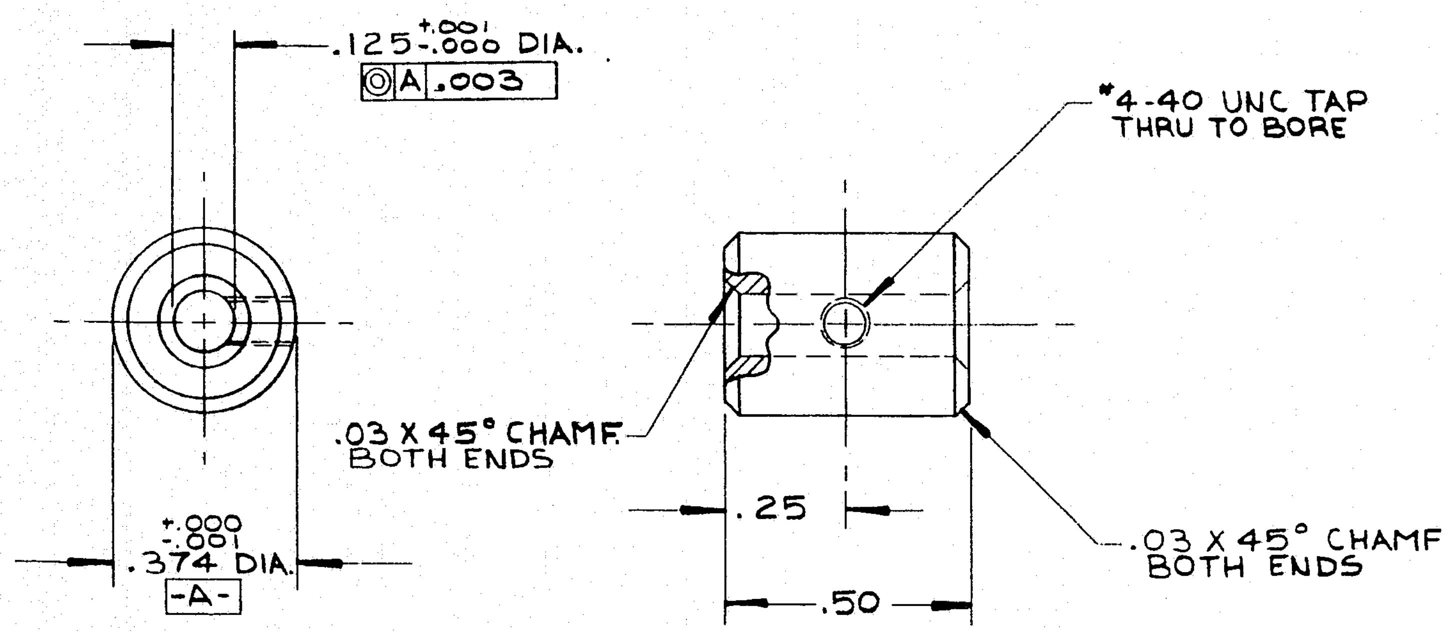
TITLE: HOLD DOWN RING

SIZE	CODE IDENT. NO.	DRAWING NO.
B	04713	R-0272-77-15

SCALE FULL | WEIGHT | SHEET 1 OF 1

NEXT ASSEMBLY	USED ON
APPLICATION	

INCH X 1/10



REVISIONS					
REV.	ECO NO.	CHANGE	DATE	BY	ENGR.

UNLESS OTHERWISE SPECIFIED,
TOLERANCES:
INCHES .XX ± .02 .XXX ± .005
MILLIMETERS .X ± / .XX ± /
ANGULAR ± /
63 √ RMS ALL MACHINED SURFACES.
FEATURE CONTROL SYMBOLS PER ANSI Y14.5.
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS.
UNDERLINED DIM NOT TO SCALE.
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED.

MATERIAL	HALF-HARD BRASS
HEAT TREAT	/
APPLIED FINISH	/
DRAWN BY	R. KASSNER II — DATE 6-7-77
CHECKED BY	DATE
ENGR. APPROVAL	DATE

MOTOROLA INC.
Discrete Semiconductor Division

TITLE: BAFFLE

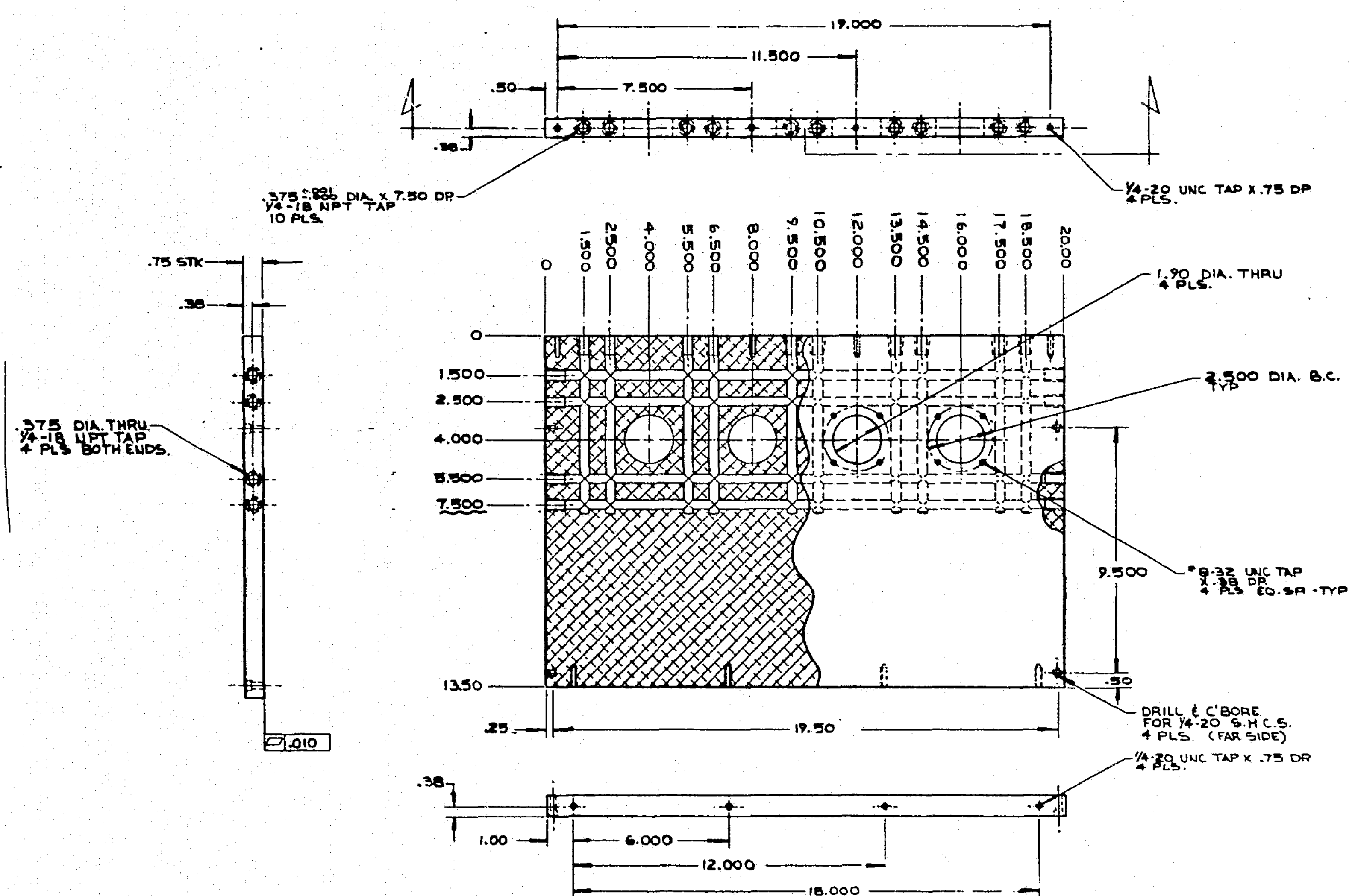
SIZE	CODE IDENT. NO.	DRAWING NO.
B	04713	R-0272-77-12

SCALE 4X | WEIGHT | SHEET 1 OF 1

NEXT ASSEMBLY	USED ON
APPLICATION	

MM 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

INCH X 1/10 1 2 3 4 5 6



UNLESS OTHERWISE SPECIFIED, TOLERANCES INCHES XX ±.02 XXX ± .005 MILLIMETERS ANGULAR	MATERIAL 6061-T6 AL.	MOTOROLA INC. Discrete Semiconductor Division
63 RMS ALL MACHINED SURFACES	HEAT TREAT	TITLE: COOLING PLATE
FEATURE CONTROL SYMBOLS PER ANSI Y14.5	APPLIED FINISH	
BREAK ALL SHARP EDGES AND CORNERS, REMOVE BURRS	DRAWN BY RKASSNER DATE 6-10-7	SIZE D · CODE IDENT NO 04713 · DRAWING NO R-0272-77-9
UNDERLINED DIM NOT TO SCALE	CHECKED BY DATE	
THIRD ANGLE ORTHOGRAPHIC PROJECTION IS USED	ENGR APPROVAL DATE	SCALE 1/2 · WEIGHT · SHEET 1 OF 1

NEXT ASSEMBLY | USED ON
APPLICATION

REVISIONS
REV | ECO NO. | ZONE | CHANGE | DATE | BY | ENGR